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Manser

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(54) **GARAGE DOOR APPARATUS WITH FOLDING DOOR PANELS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 542 days.

(21) Appl. No.: **12/546,766**

(22) Filed: **Aug. 25, 2009**

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Related U.S. Application Data

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(51) **Int. Cl.**
E05D 15/00 (2006.01)

(52) **U.S. Cl.** **160/201**; 160/133; 160/209

(58) **Field of Classification Search** 160/133, 160/201, 209

See application file for complete search history.

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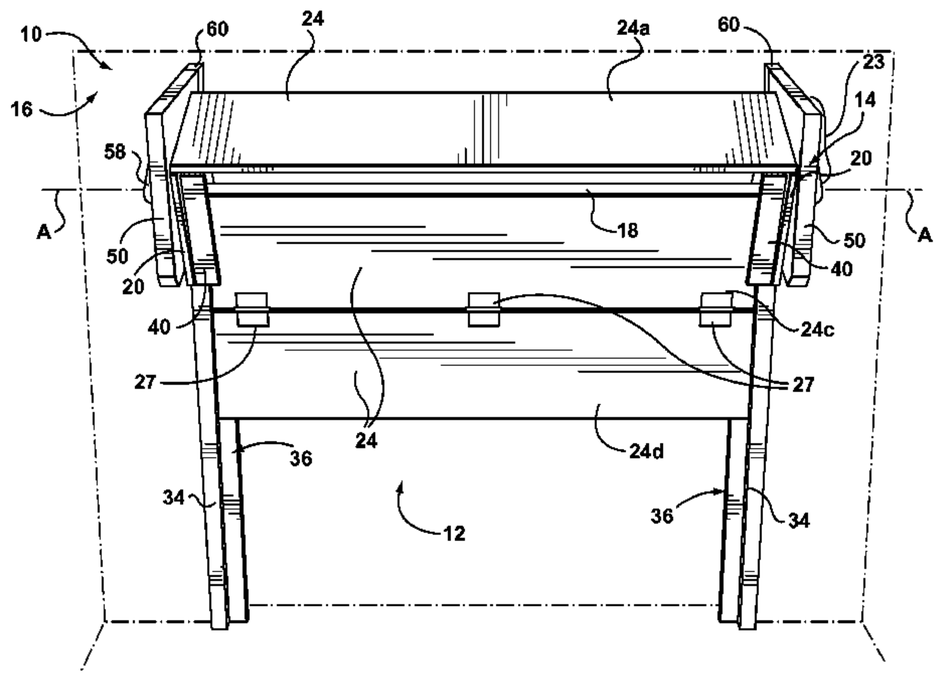
(57) **ABSTRACT**

A garage door apparatus includes a frame for mounting above an opening, the frame comprising a pair of spaced transverse frame members, a shaft rotatably coupled to the transverse frame members and extending along a longitudinal axis of rotation between the transverse frame members, a pair of spaced winding frames rigidly coupled to the shaft between the spaced transverse frame members, each of the winding frames having a plurality of side edges, a driver couplable to the shaft for rotating the shaft with respect to the transverse frame members, and a plurality of door panels hingedly coupled together and linked to the winding frames, each of the door panels being of equal width and having a longitudinal panel length, the plurality of door panels including at least one inner door panel and at least one outer door panel, wherein the winding frames are spaced apart a predetermined distance that is less than the longitudinal panel length of the plurality of door panels, such that when the winding frames are rotated by the driver about the axis of rotation, the side edges of the winding frames progressively engage each of the door panels, thereby moving the door panels between an extended position wherein the door panels obstruct the opening, and a retracted position wherein each door panel is wound onto one of the side edges of the winding frames, the opening is at least partially unobstructed, and the at least one outer door panel overlaps with the at least one inner door panel.

15 Claims, 20 Drawing Sheets



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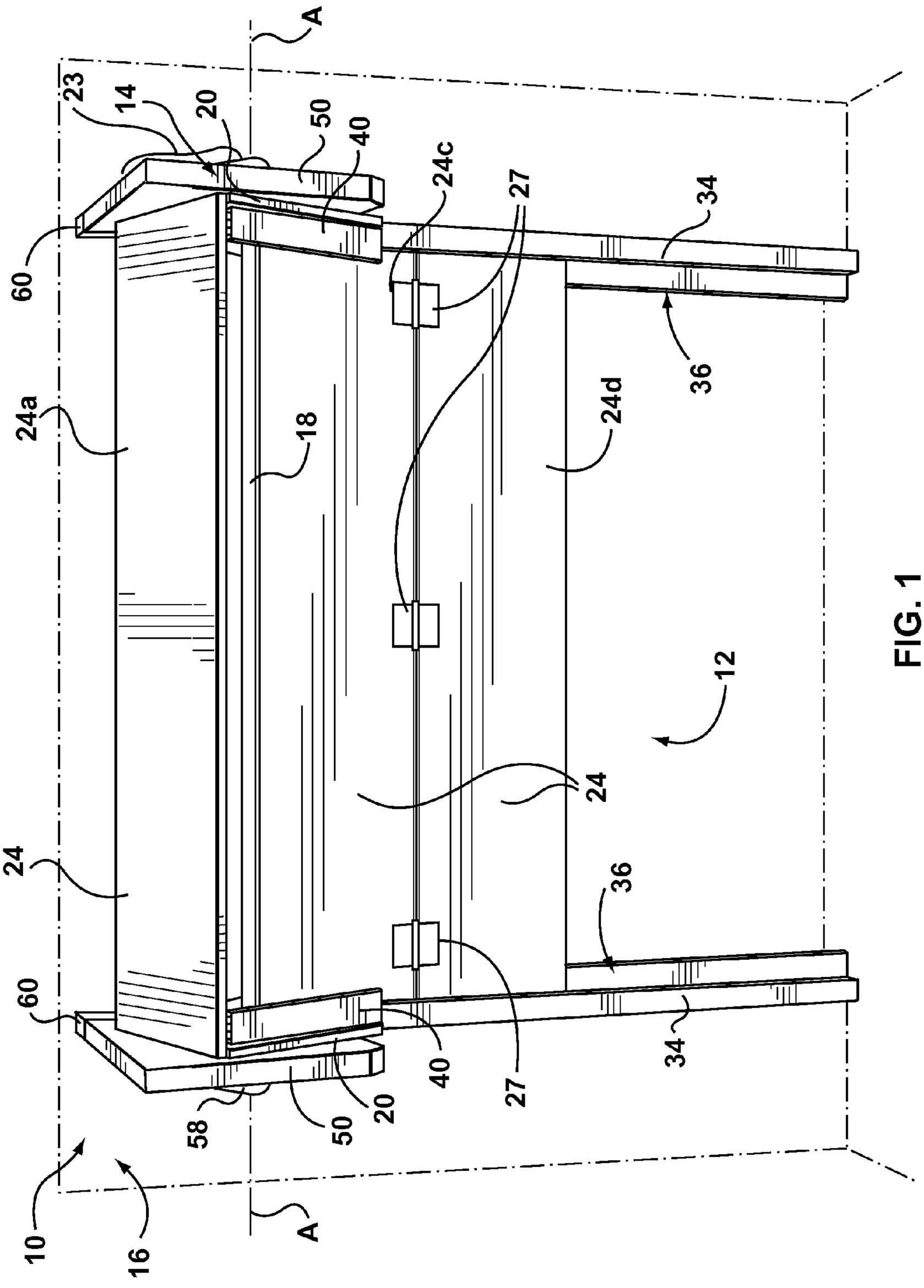
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16
A

FIG. 1

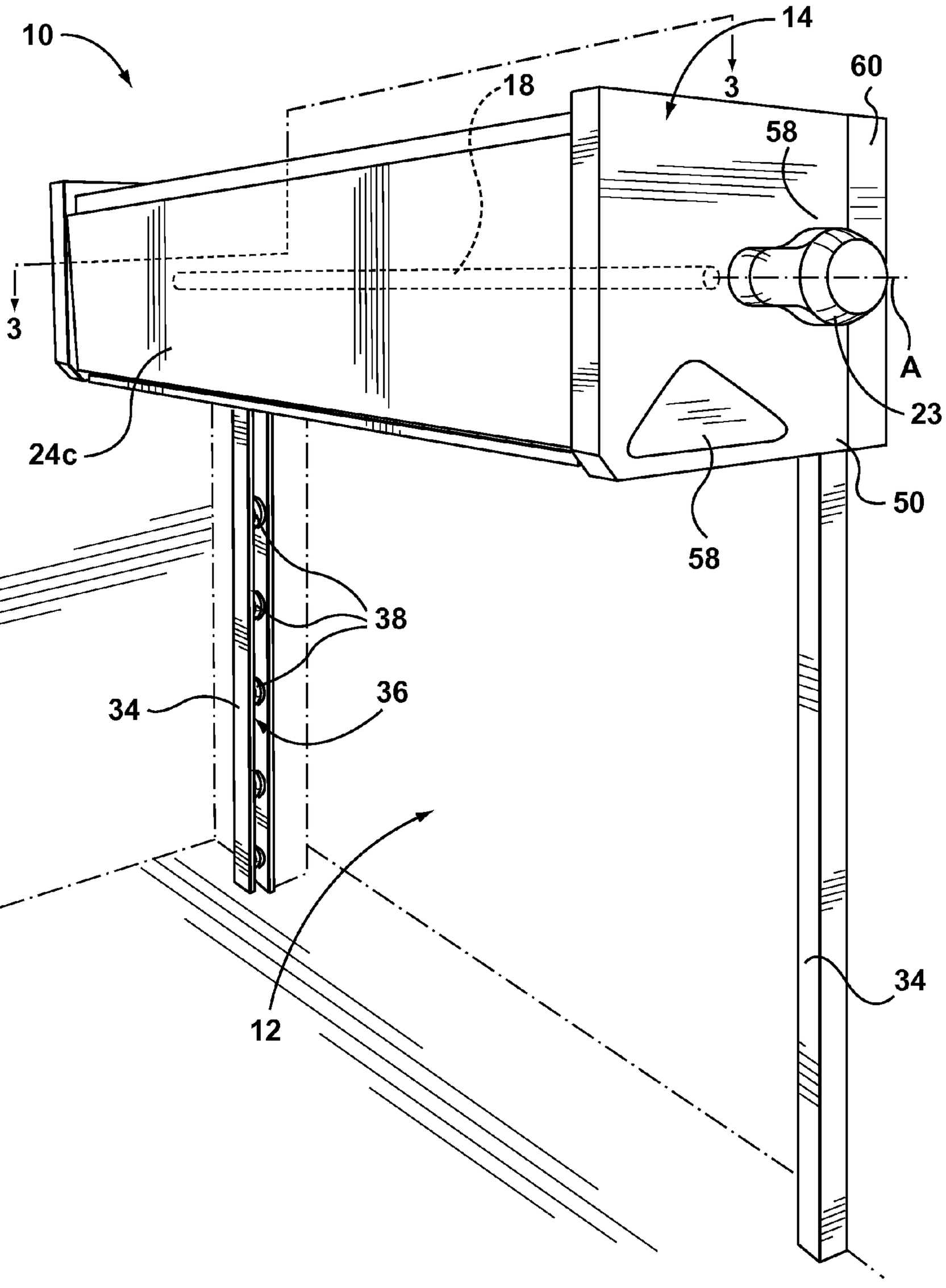
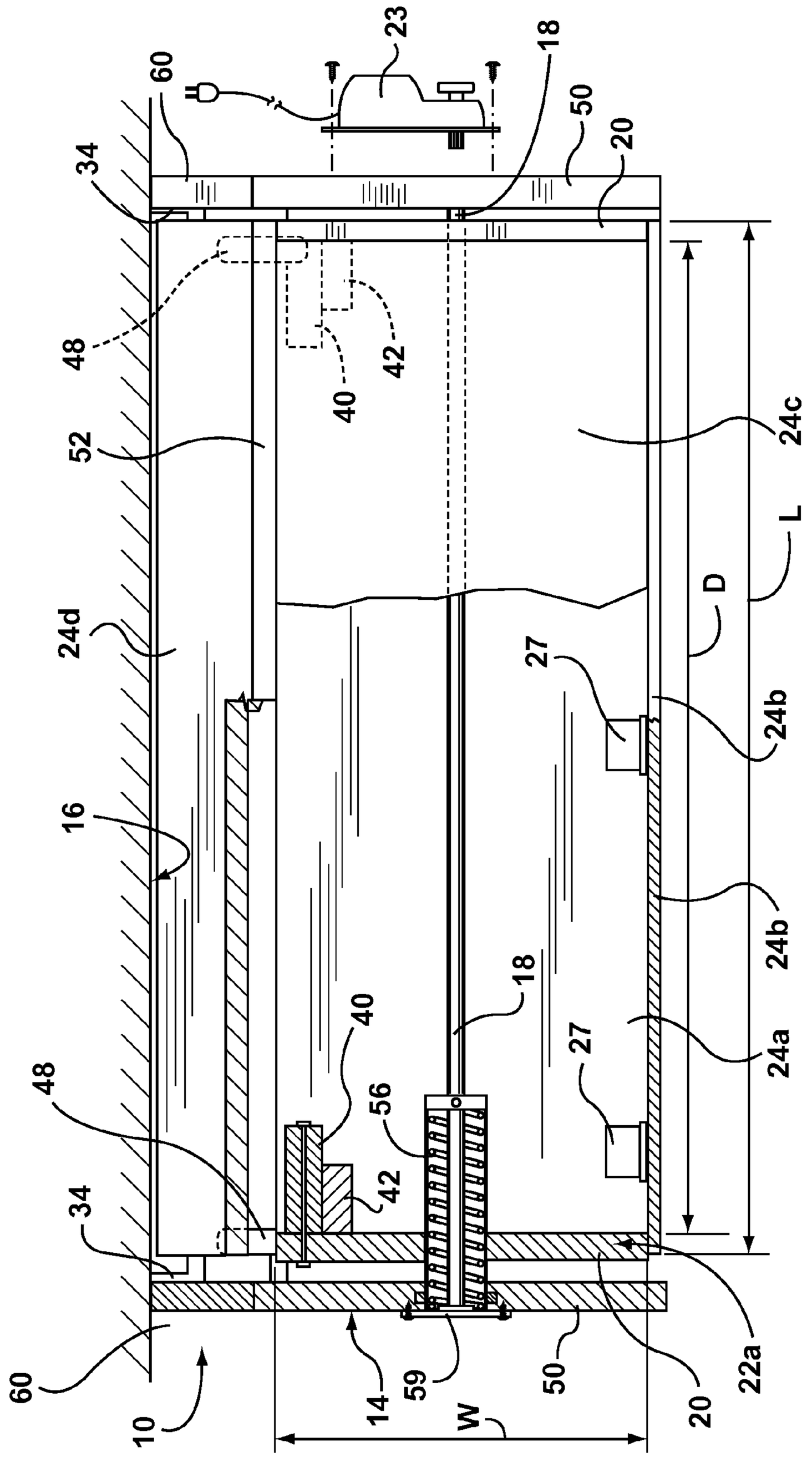


FIG. 2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24c
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22a
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W
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FIG. 3

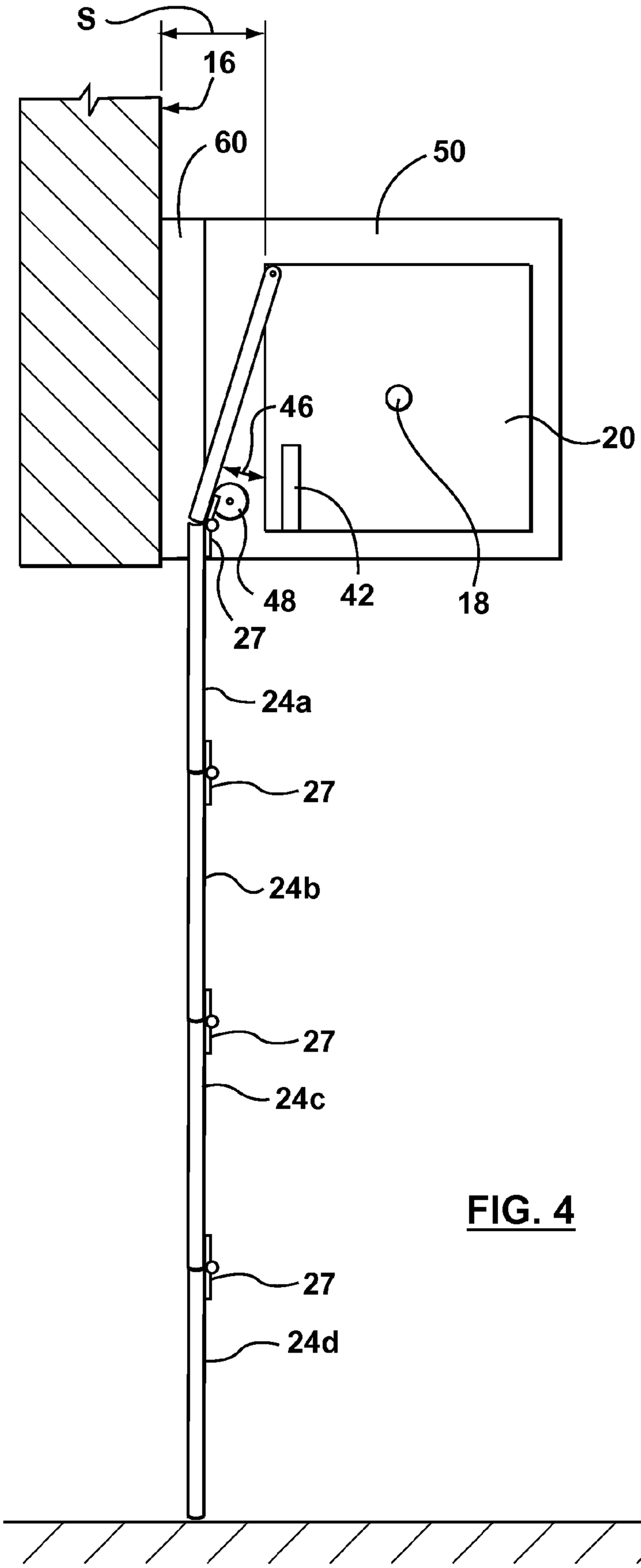


FIG. 4

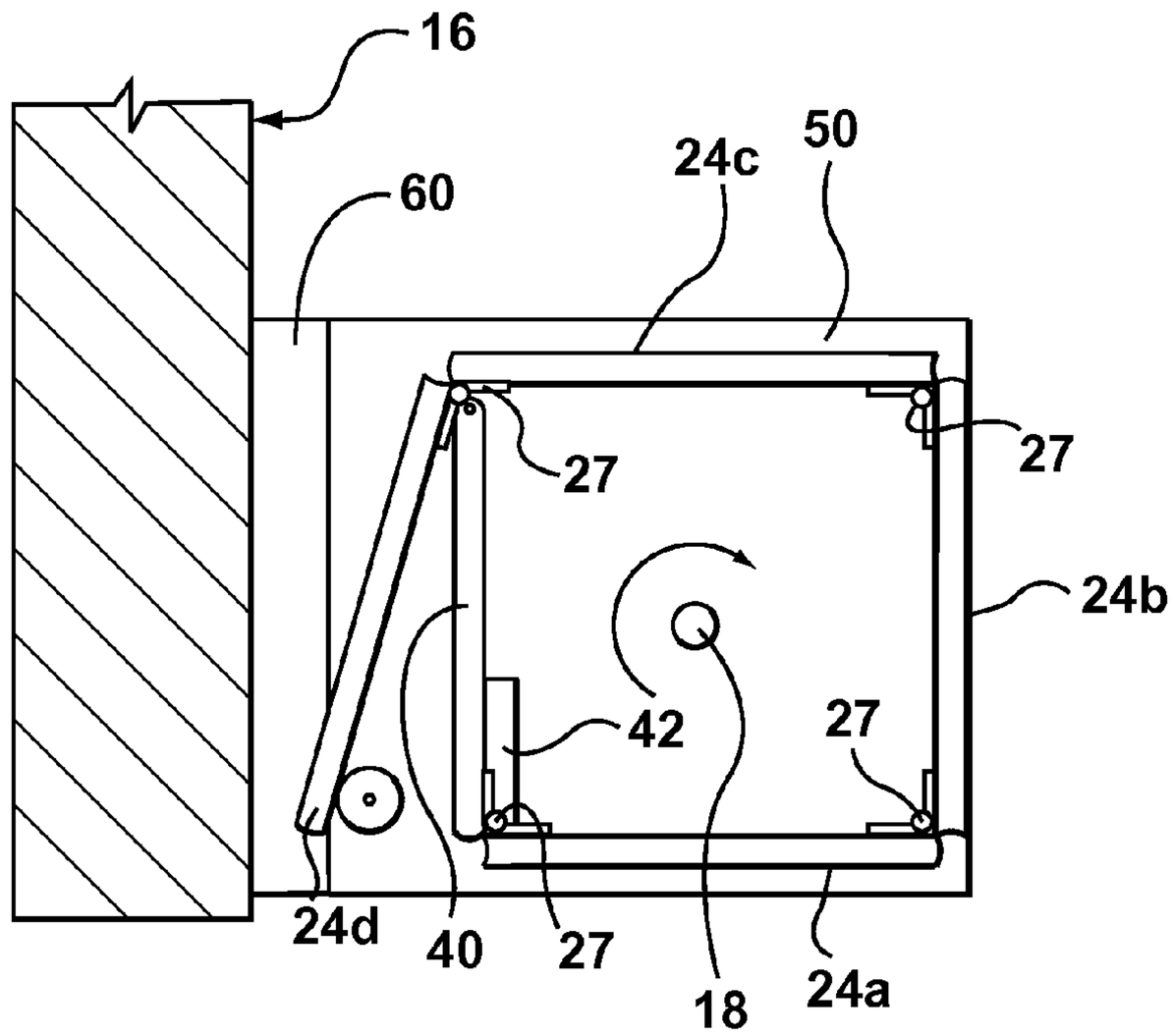


FIG. 5

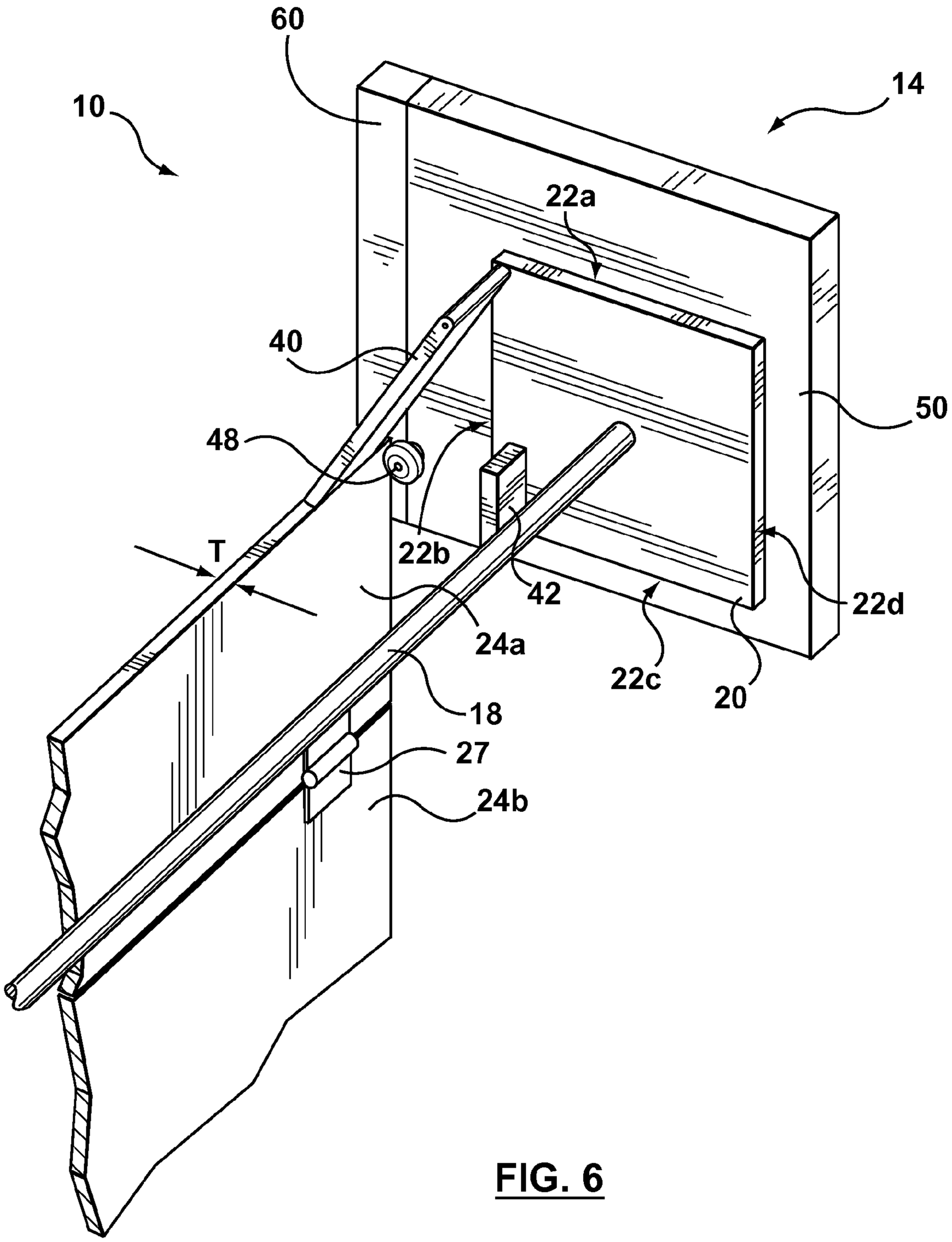
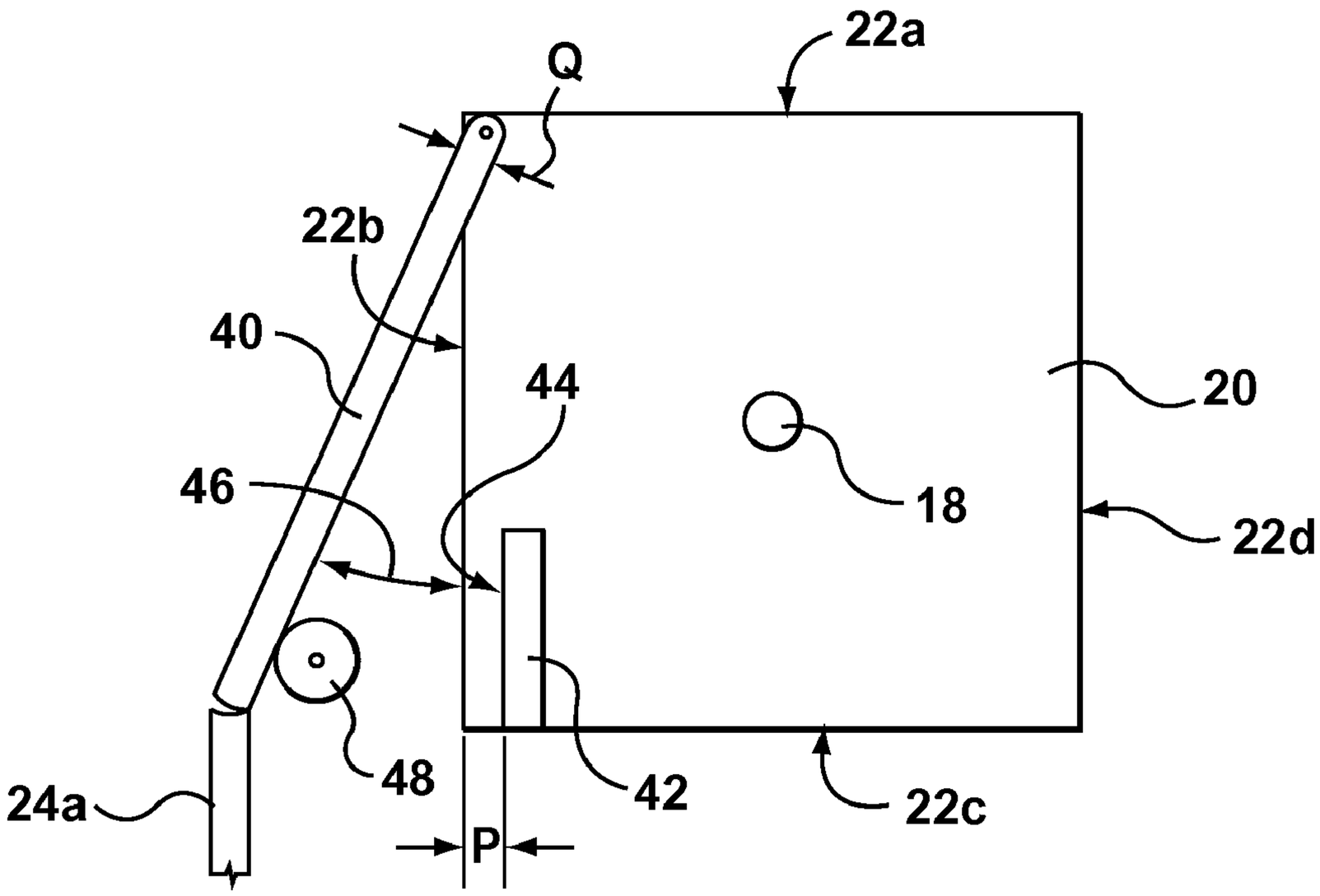


FIG. 6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Q
22b
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44
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46
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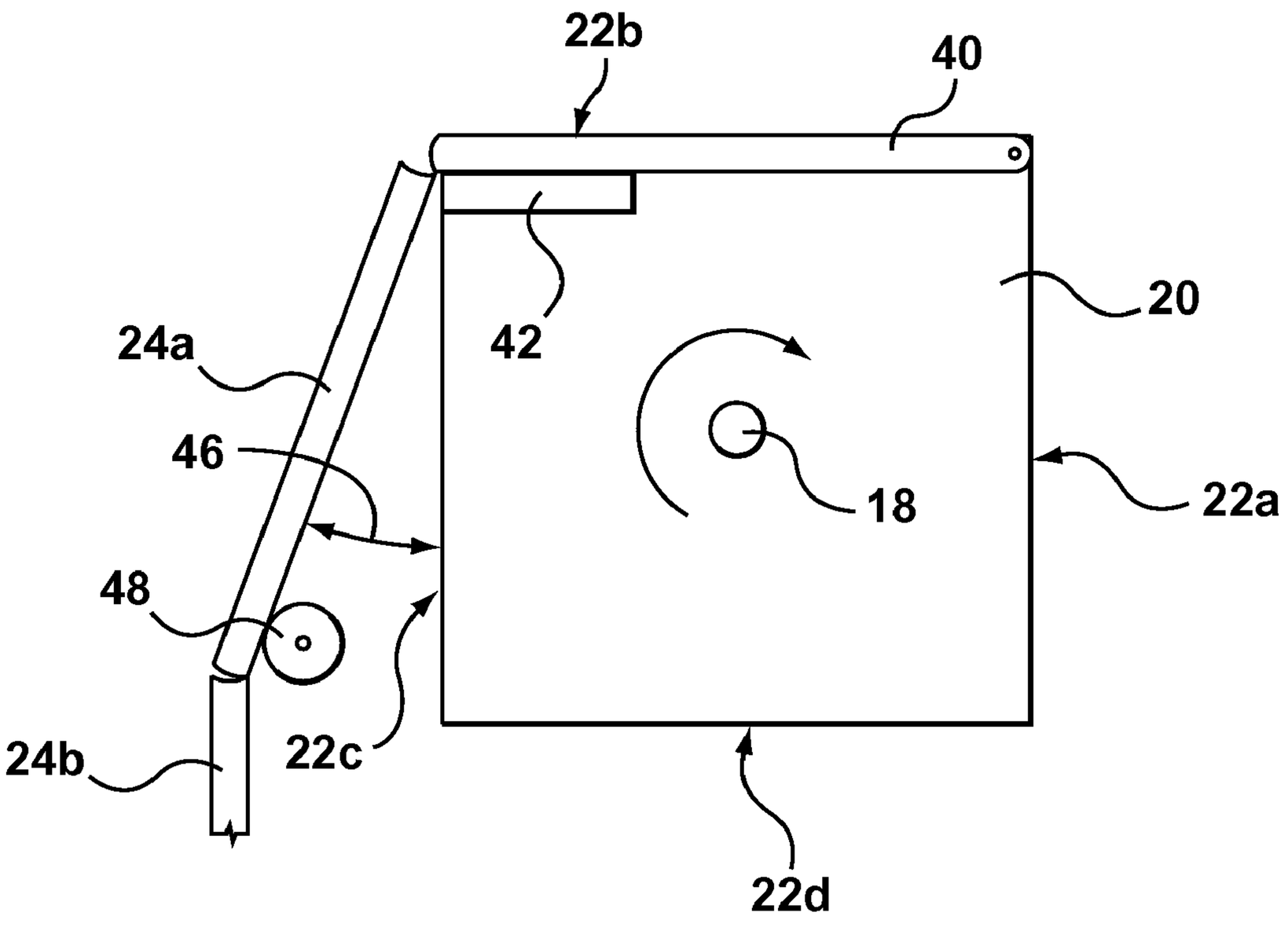
22d
48
42
24a
22c
P

FIG. 7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24a
46
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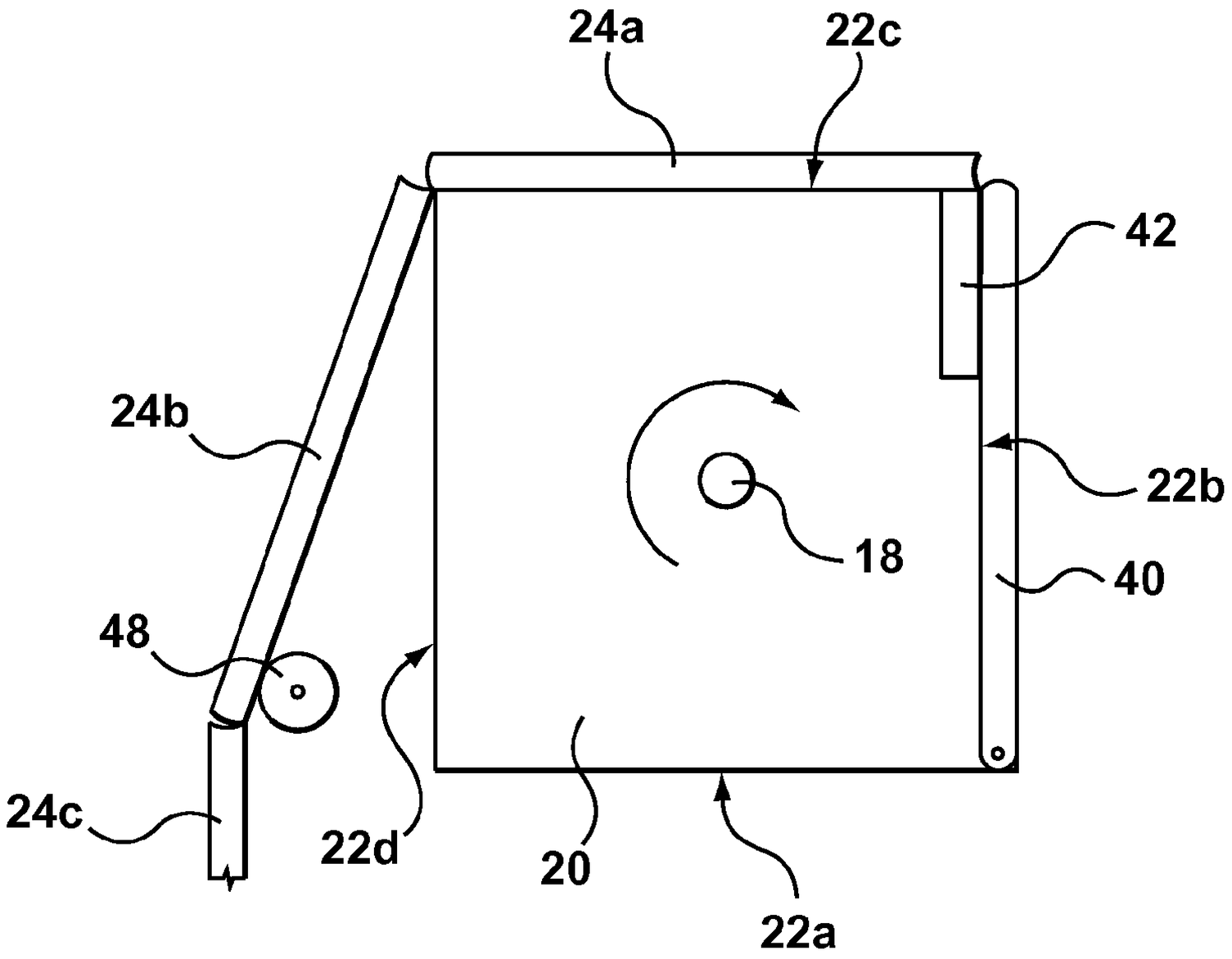
48
22c
24b
22d

FIG. 8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22c
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24b
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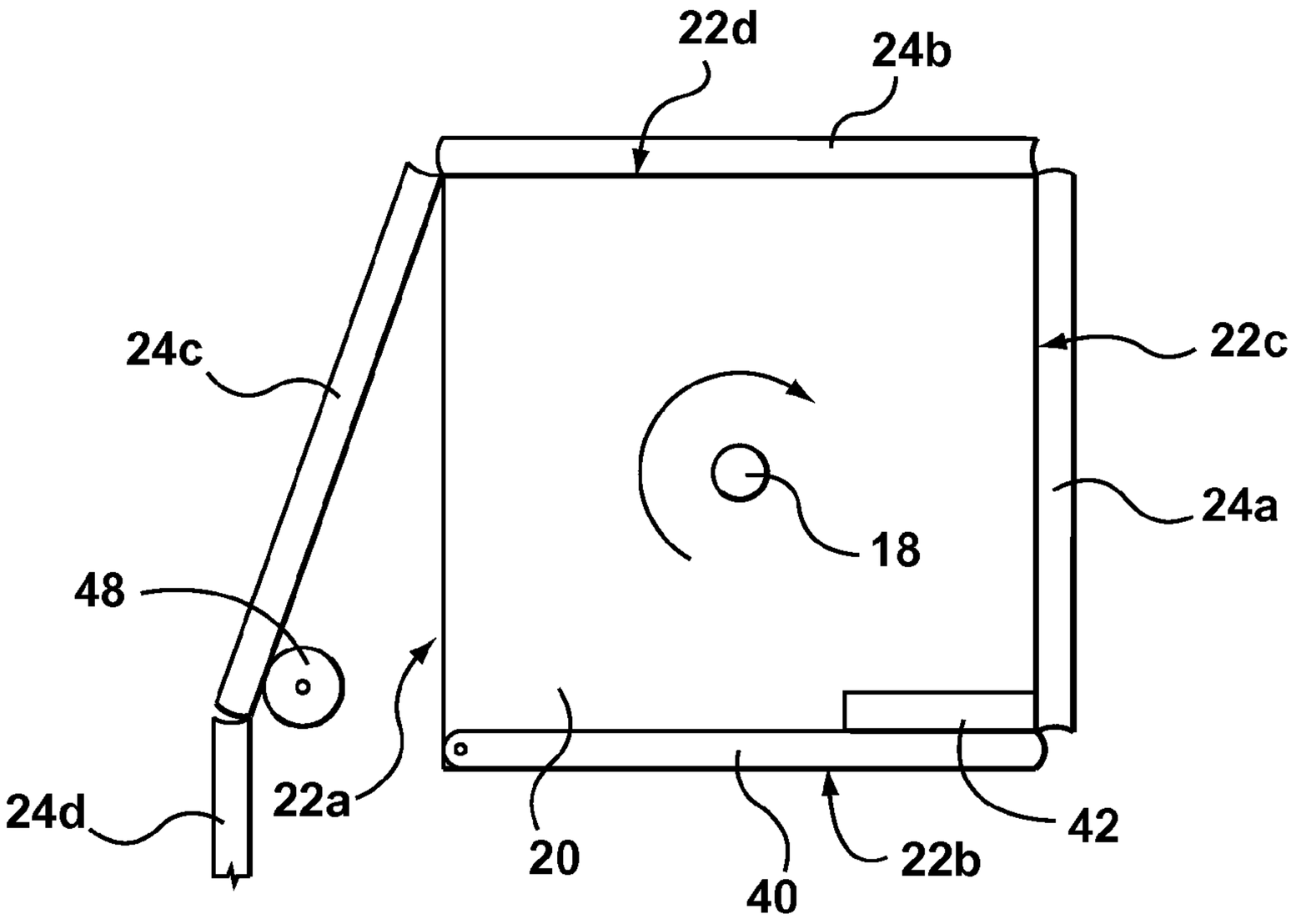
24c
22d
20
22a

FIG. 9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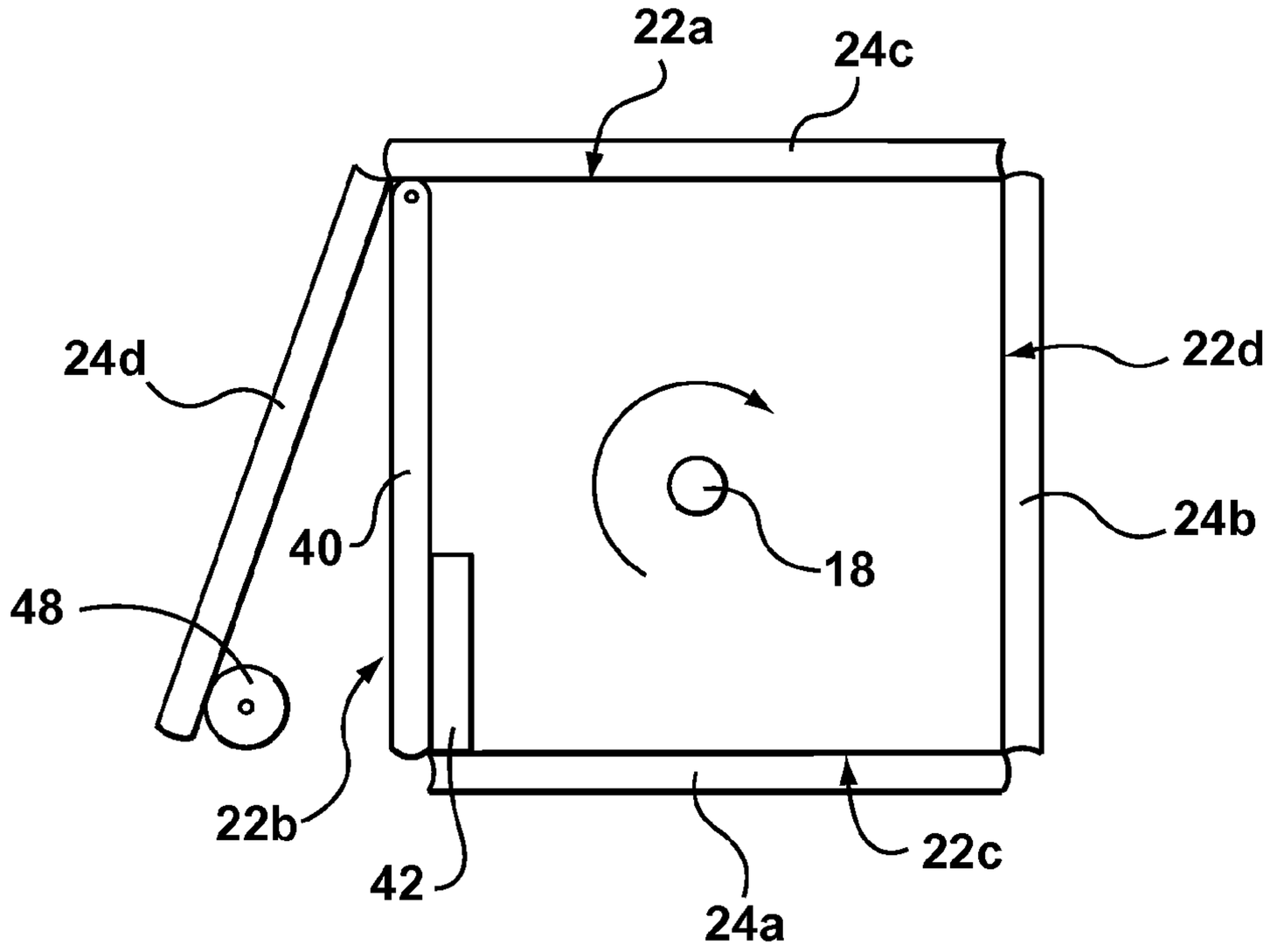
22b
42

FIG. 10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24c
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24b
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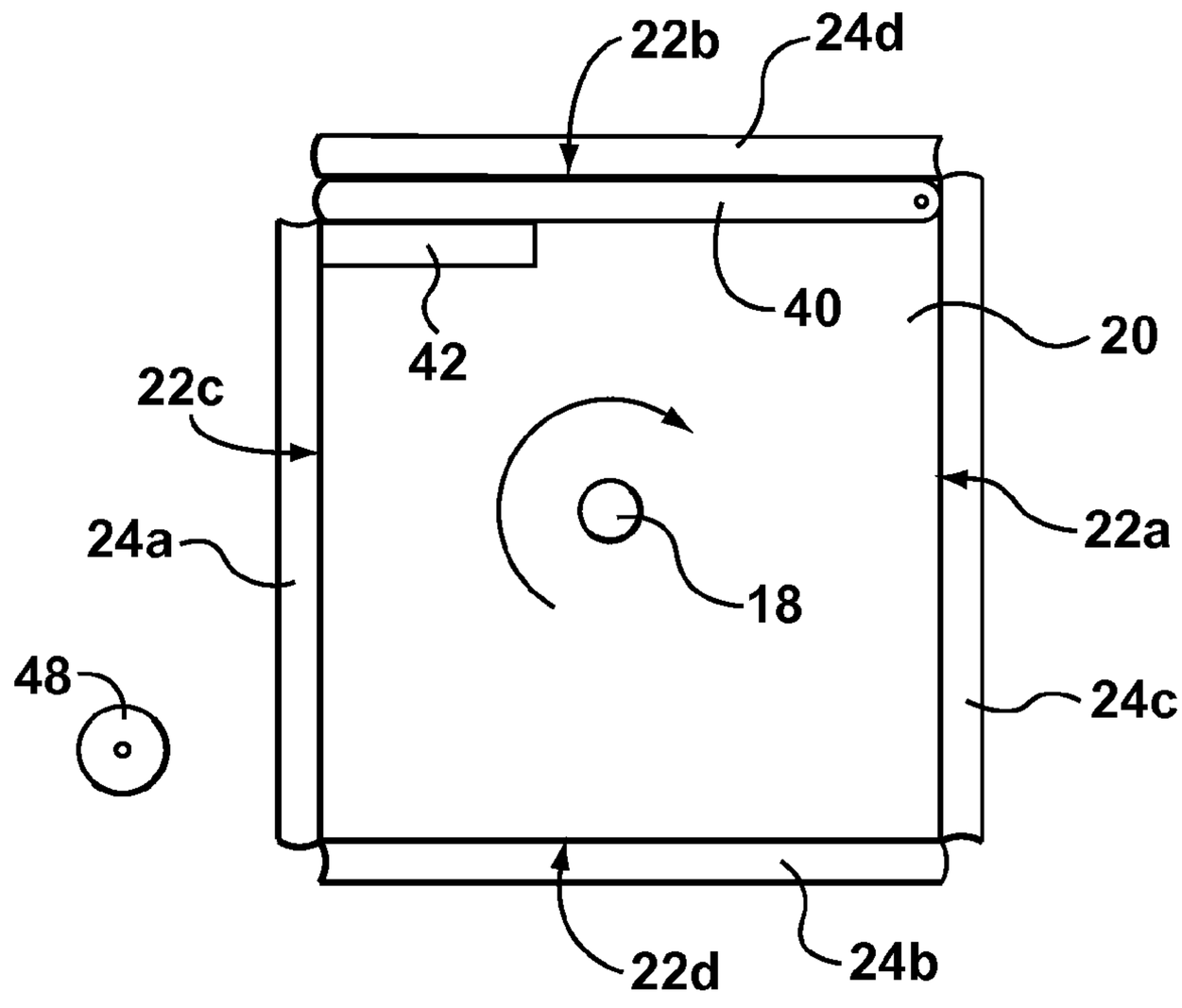
22b
42
22c
24a

FIG. 11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24d
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40
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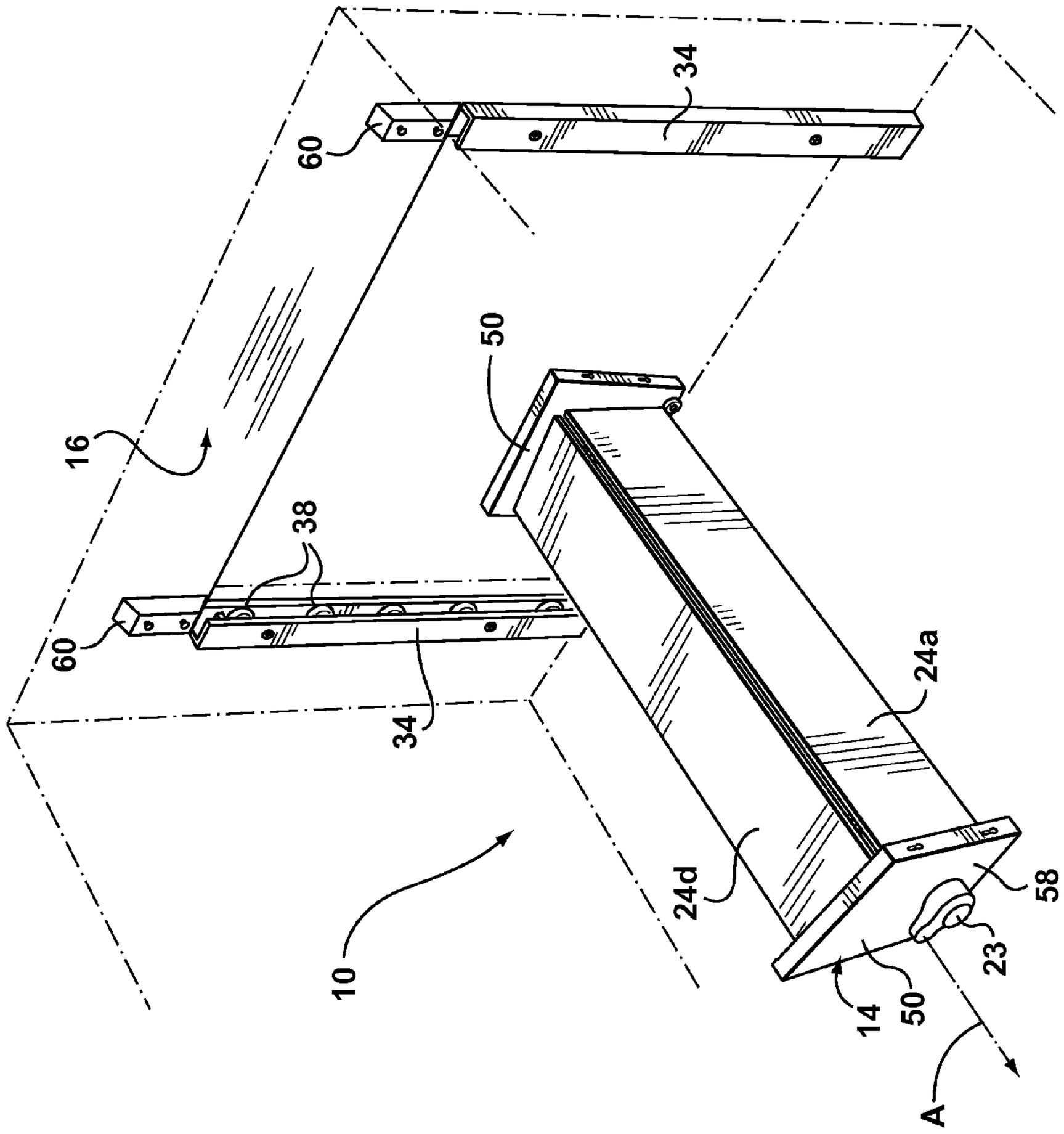
22c
24a
18
22a
48
24c
22d
24b

FIG. 12

FIG. 13



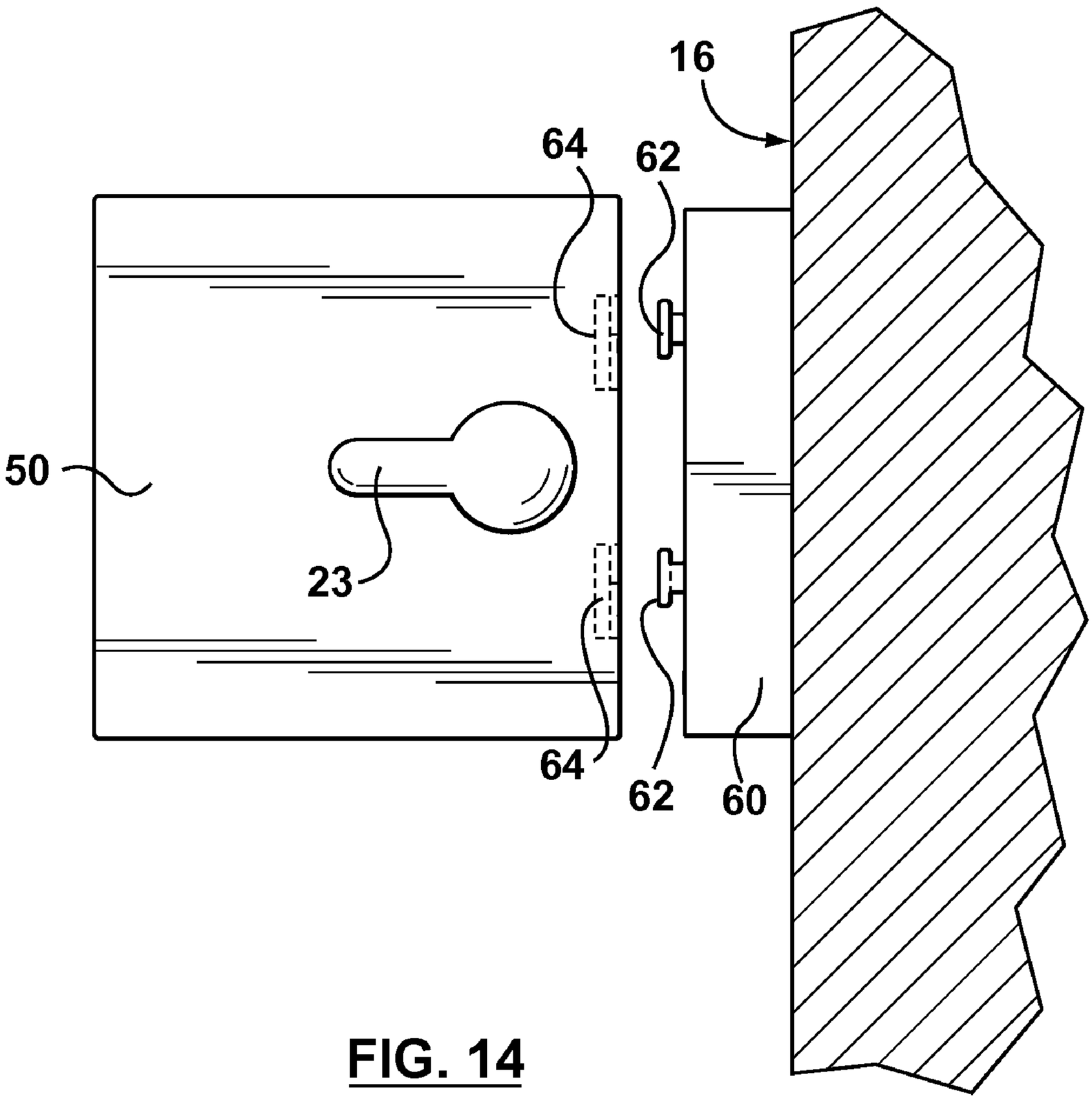


FIG. 14

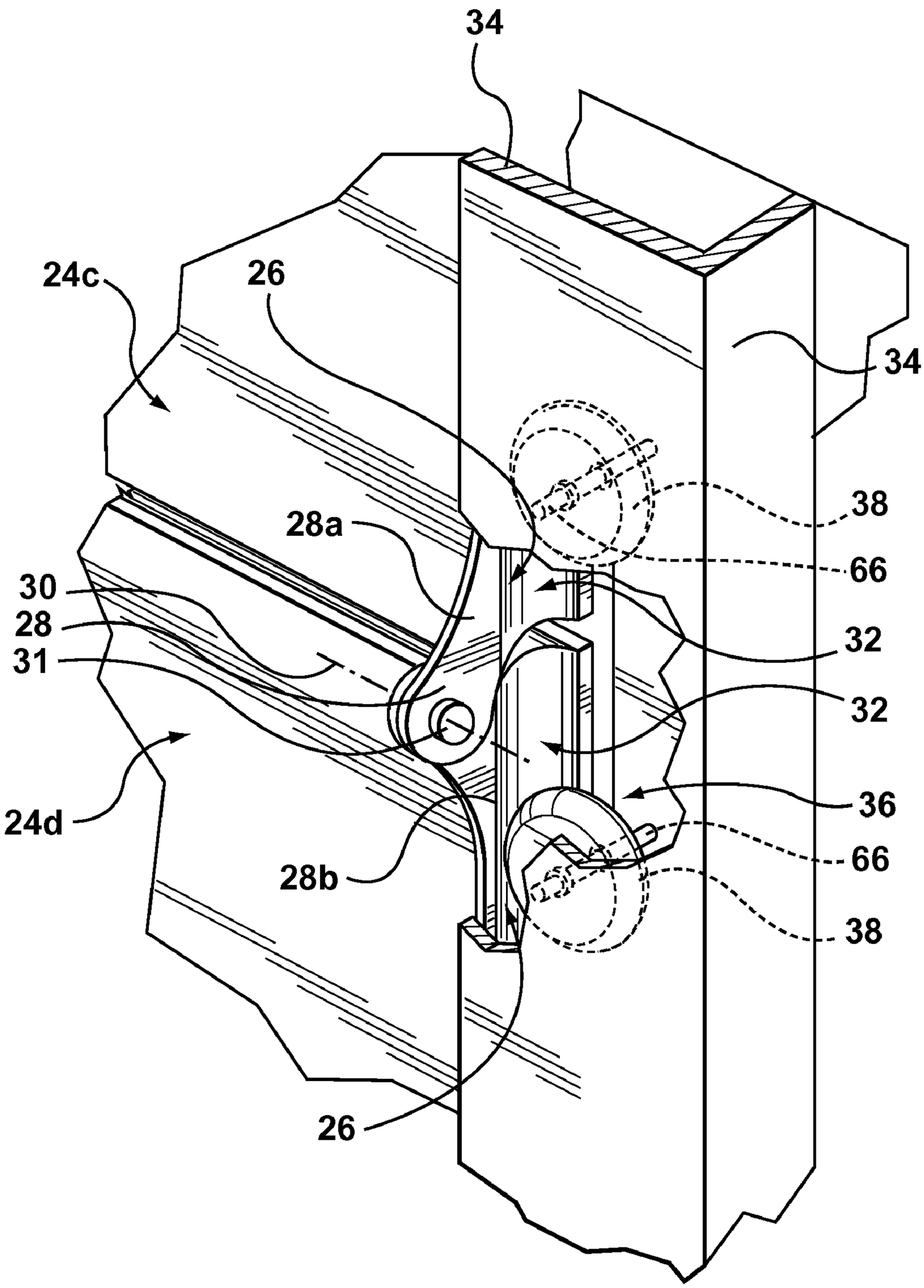


FIG. 15

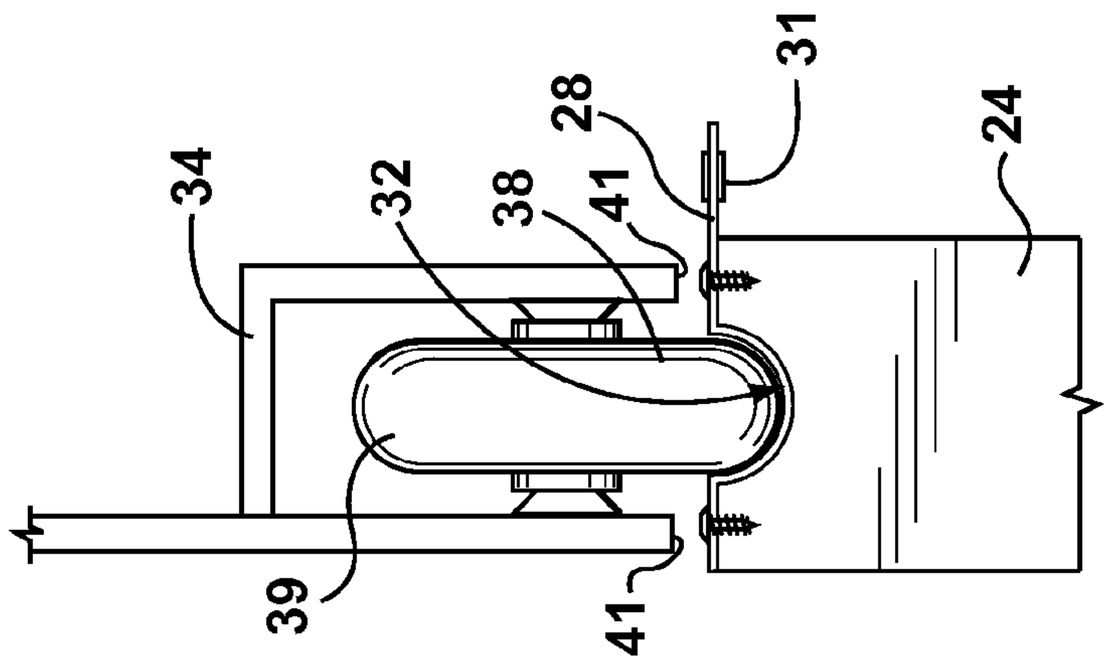


FIG. 18

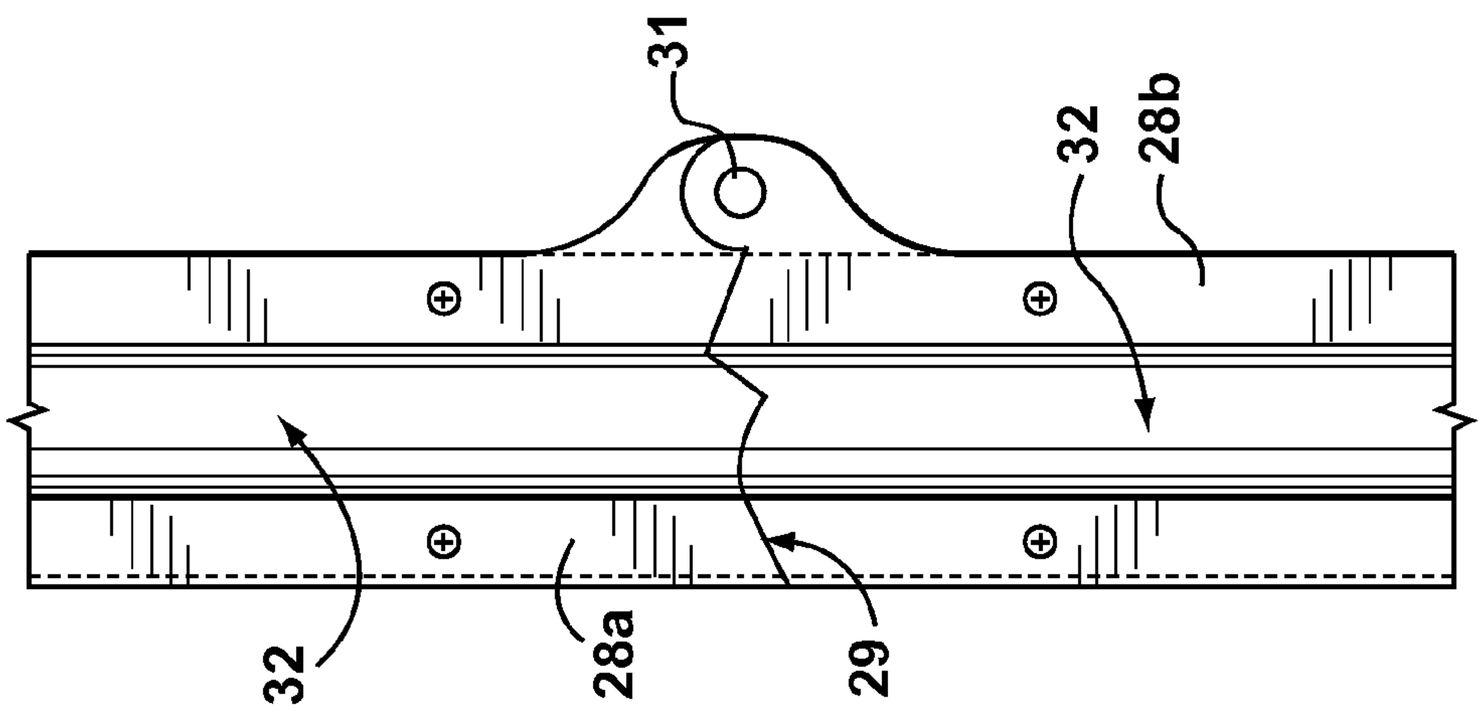


FIG. 17

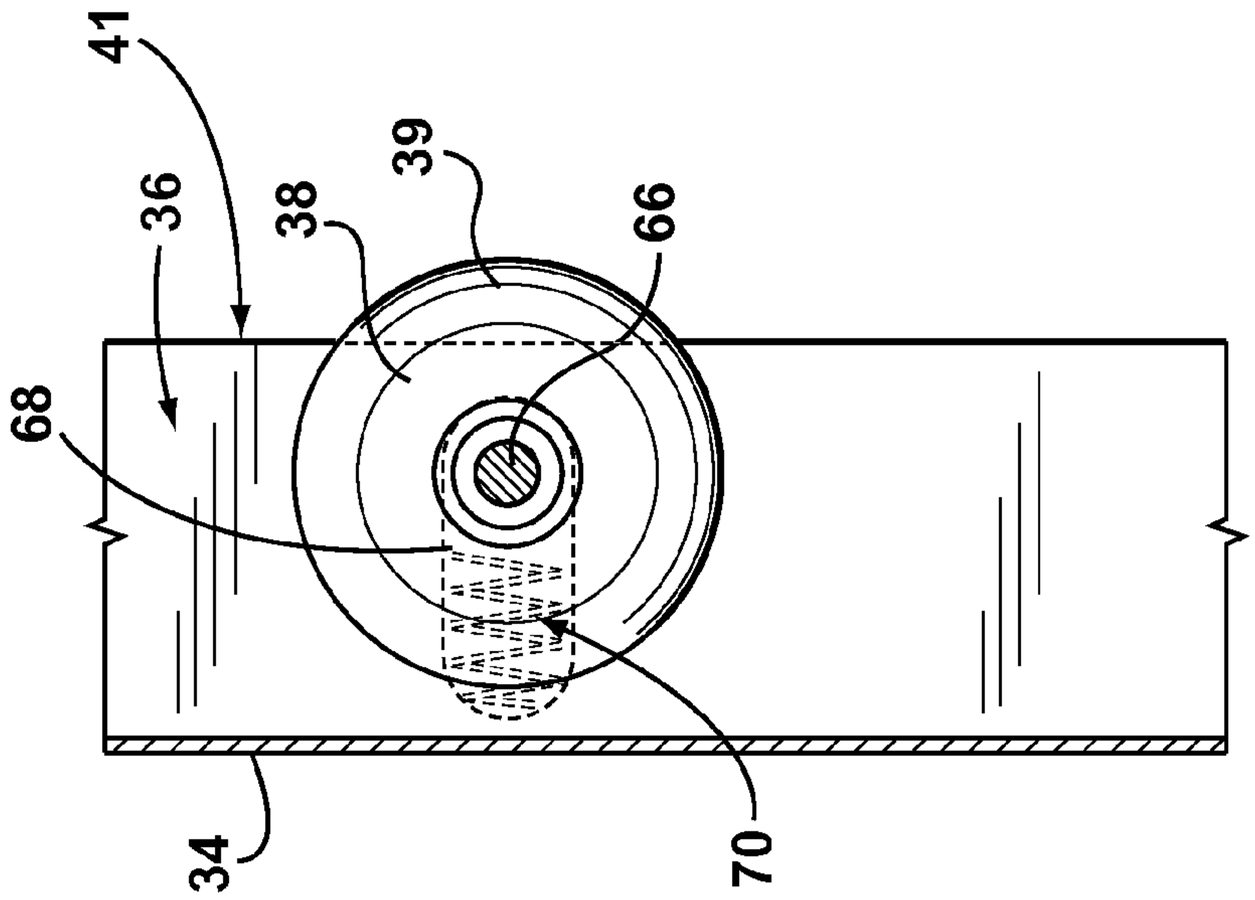
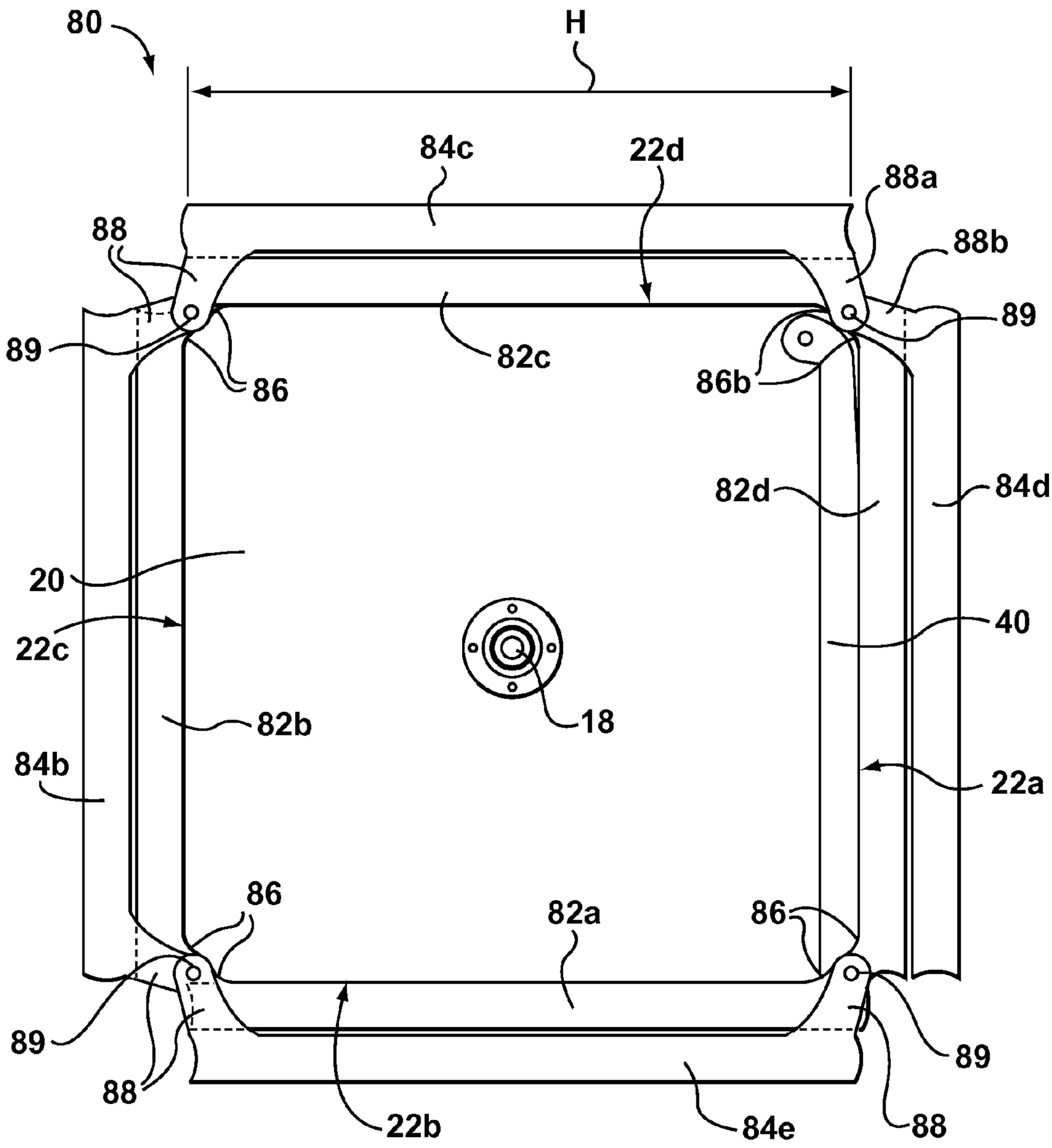


FIG. 16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H
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22d
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88b
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89
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82c
86b
82d
84d
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22c
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82b
84b
22a
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82a
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88
22b
84e
88
89

FIG. 19

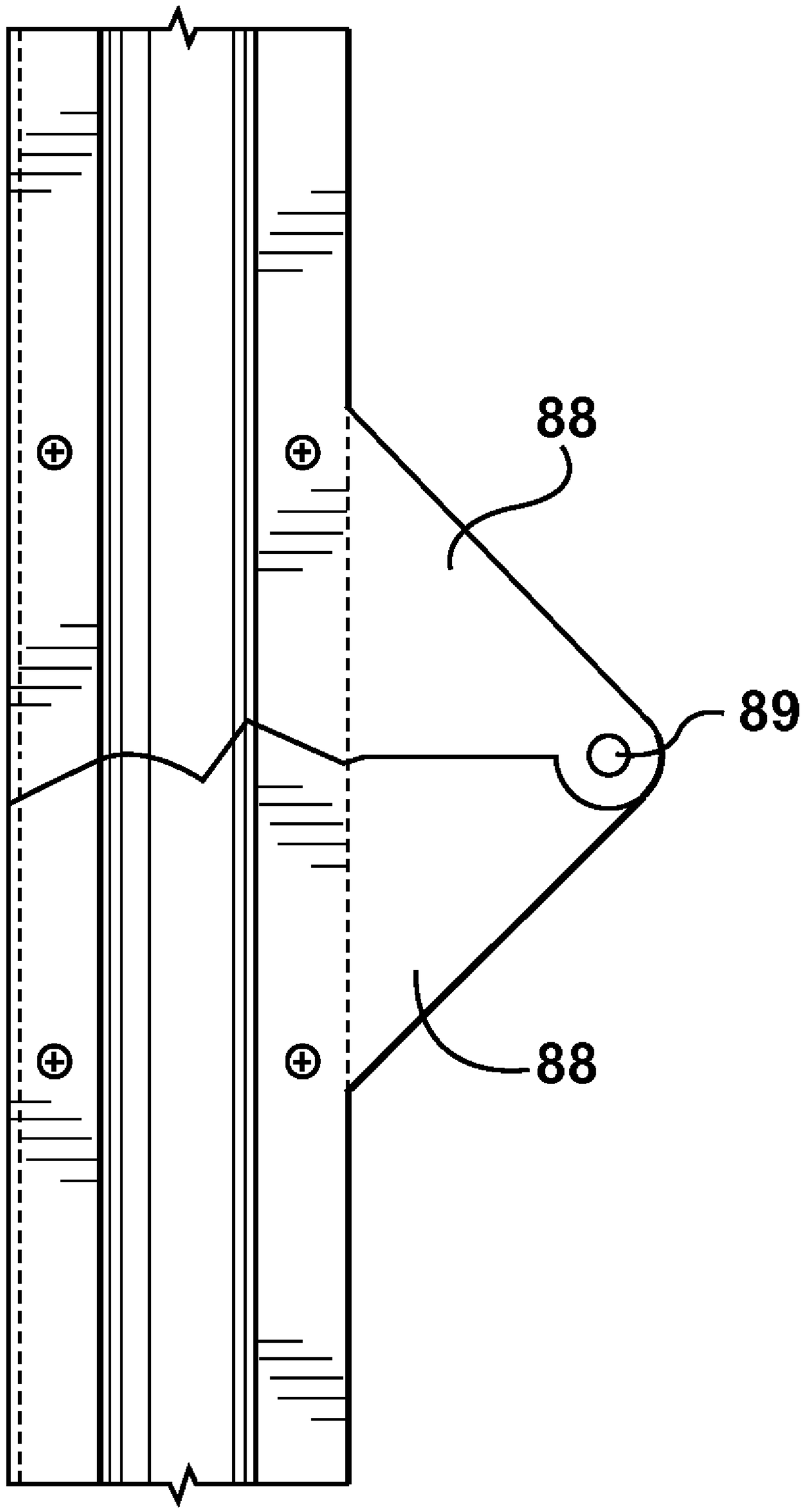

FIG. 20

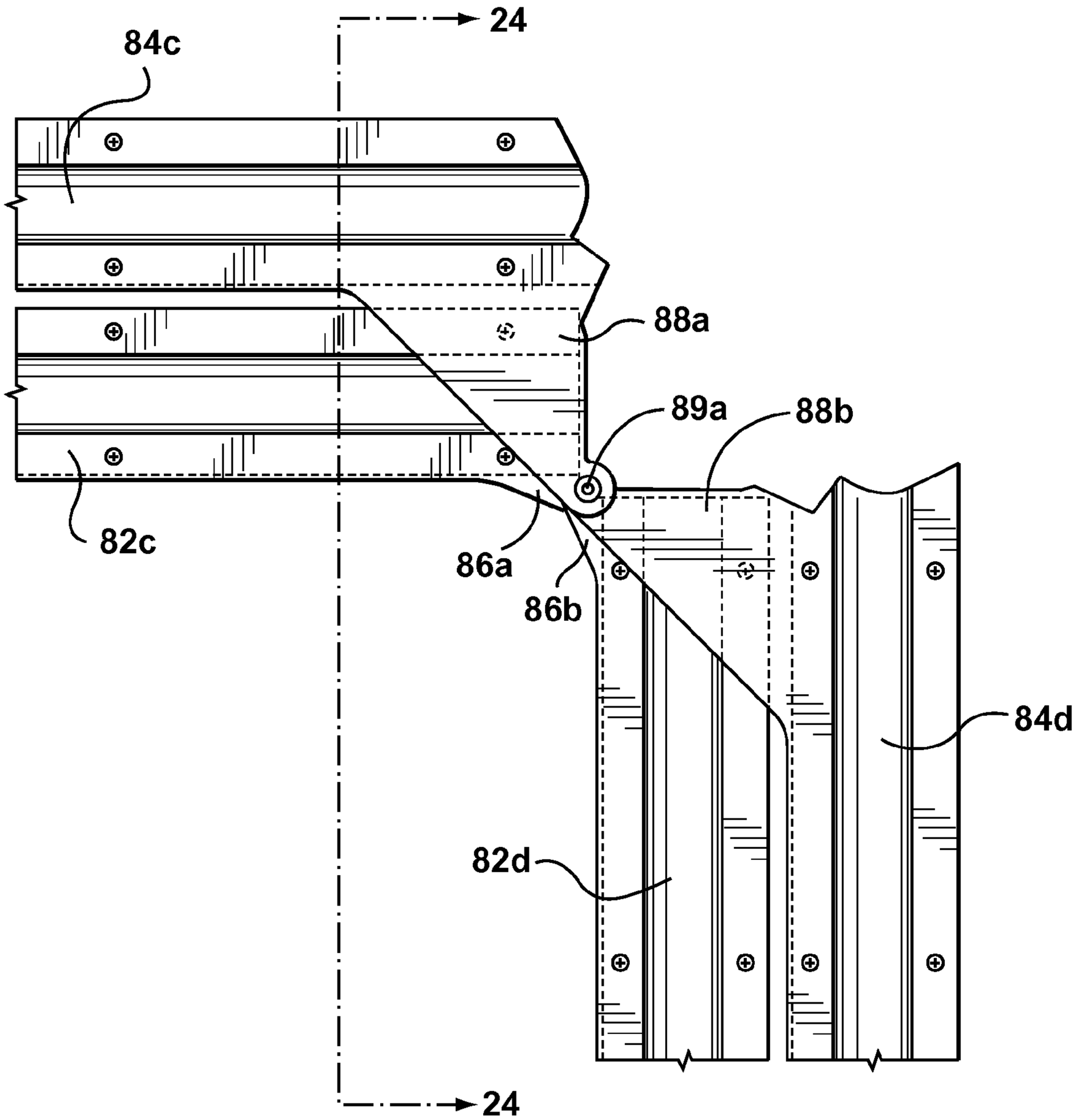

FIG. 21

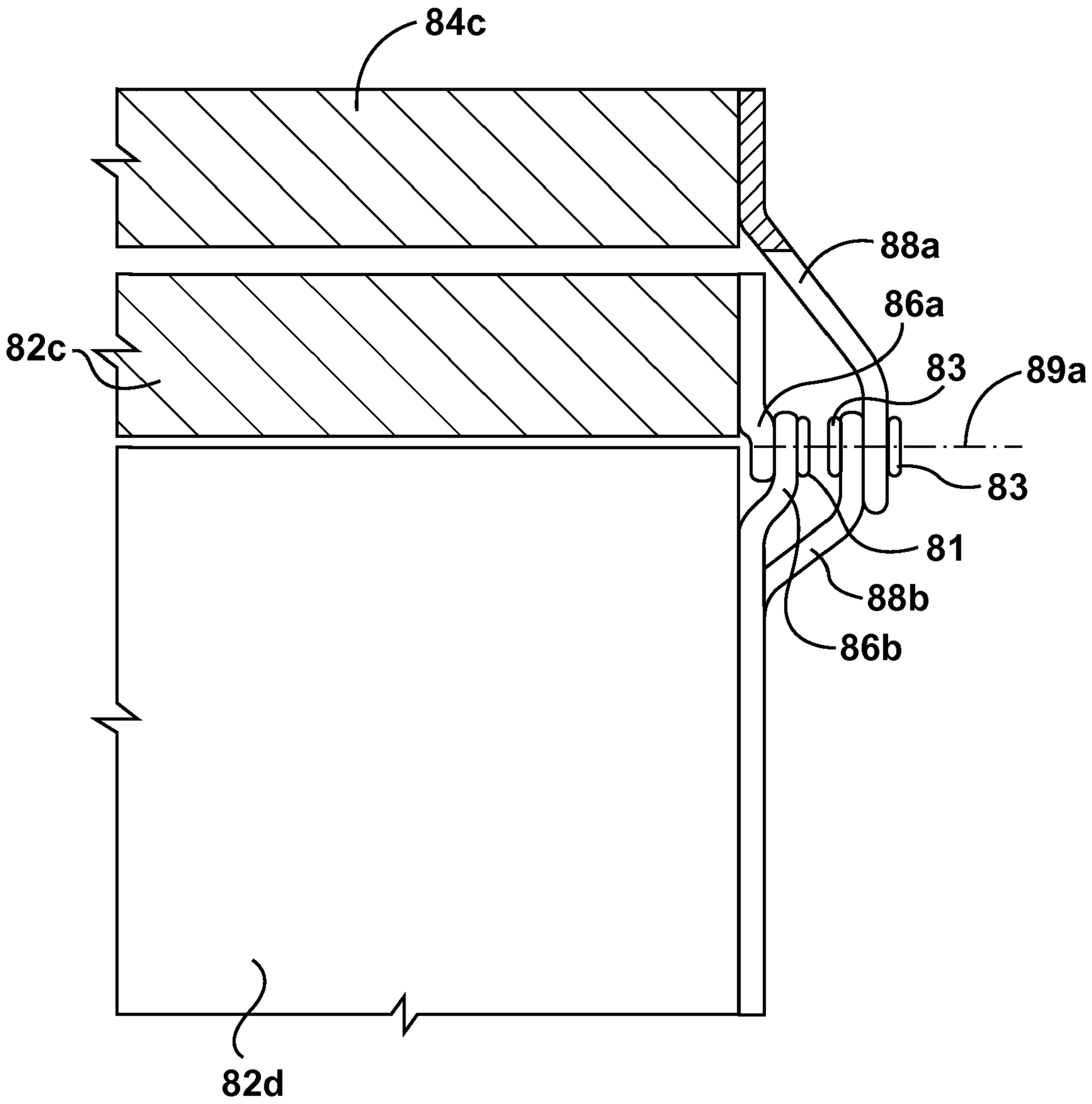

FIG. 22

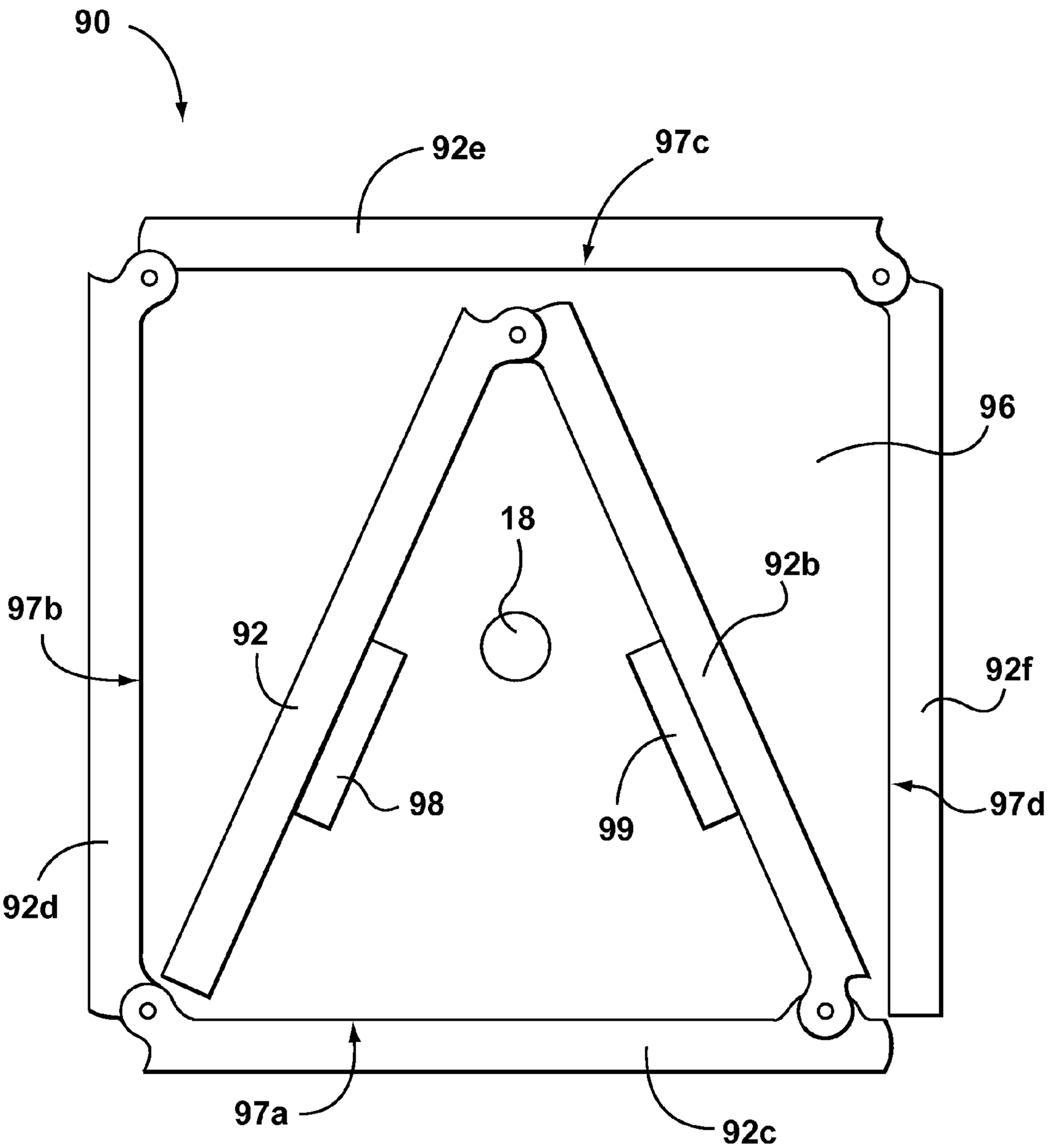

FIG. 23

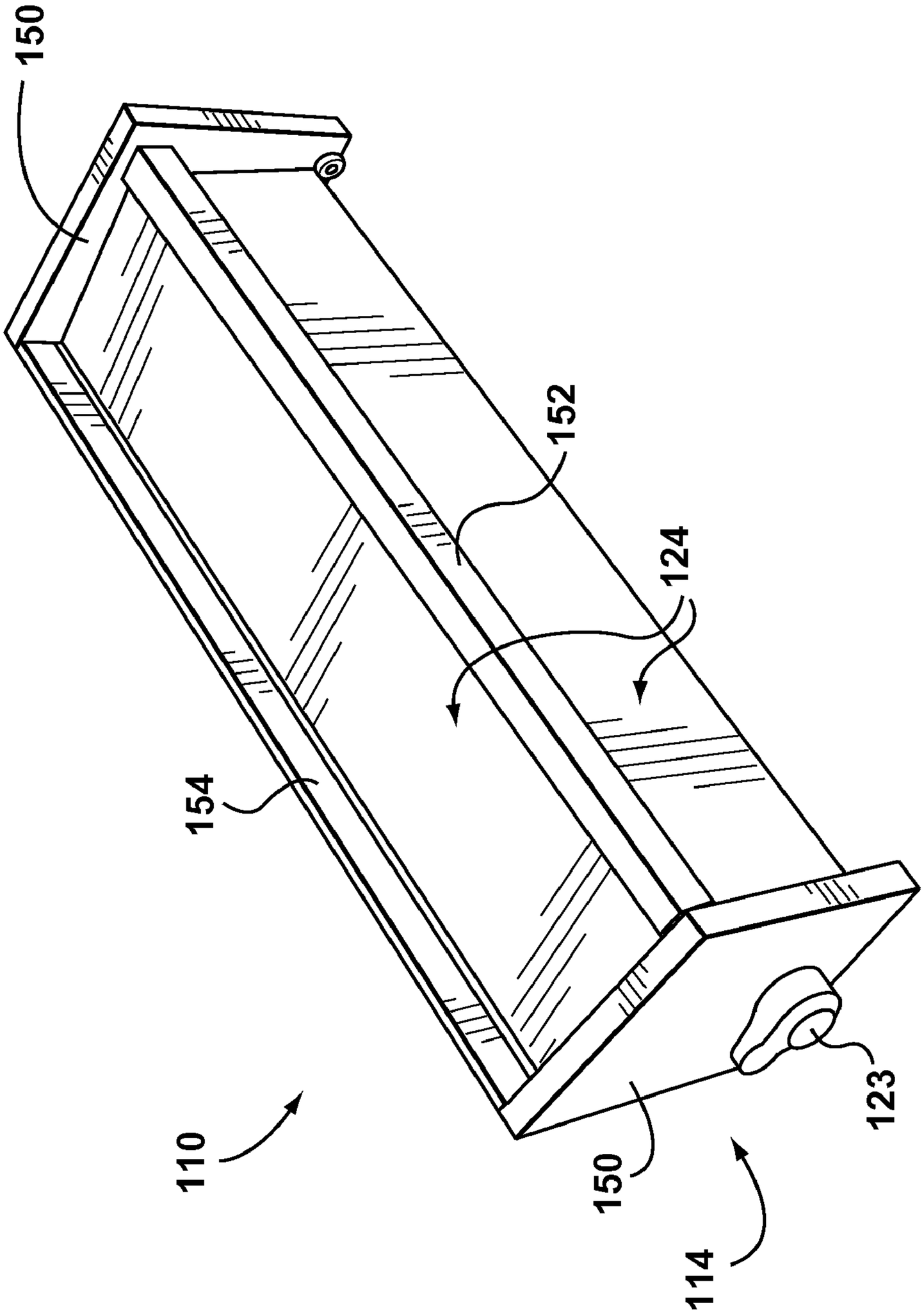

FIG. 24

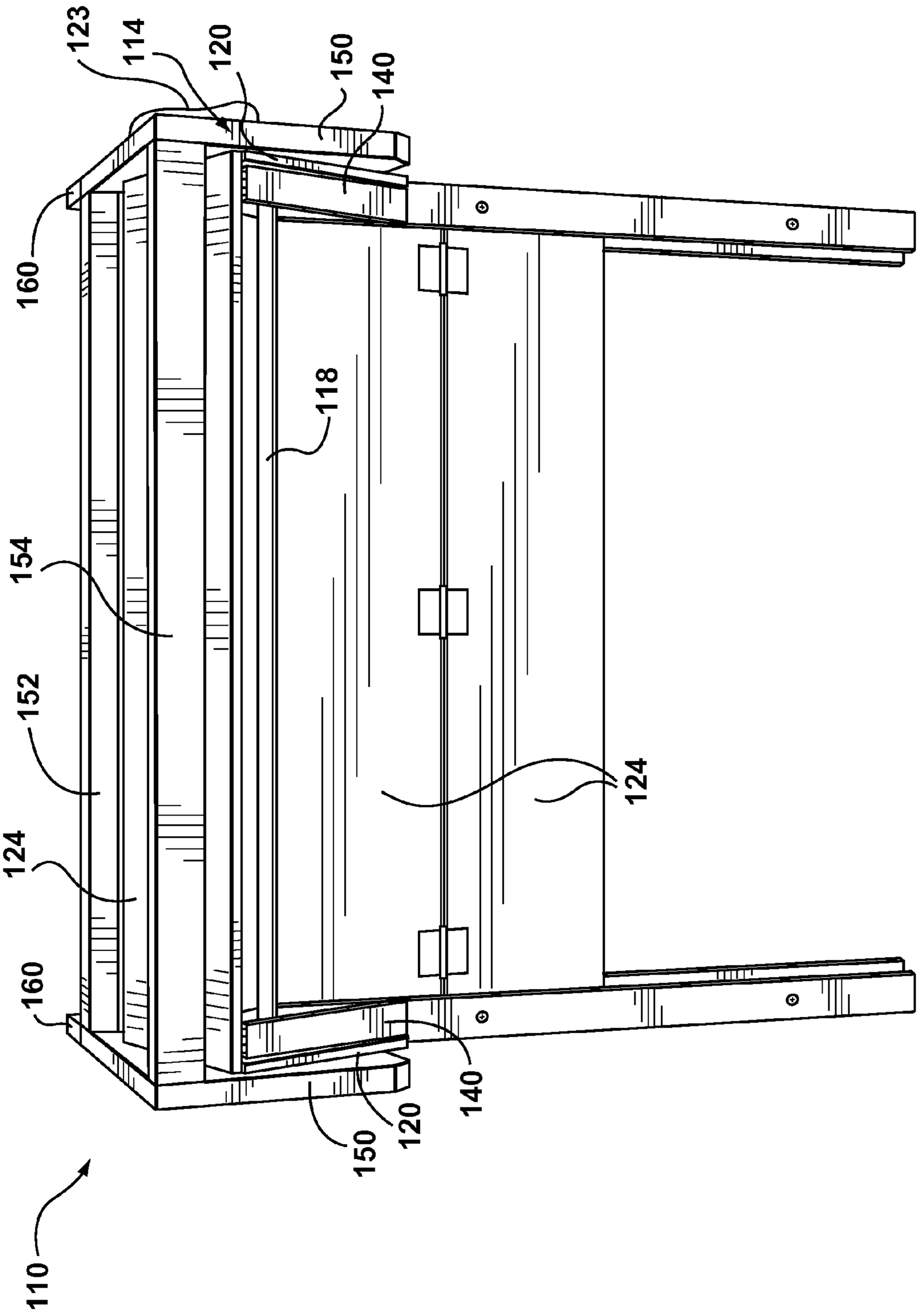

FIG. 25

GARAGE DOOR APPARATUS WITH FOLDING DOOR PANELS

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/091,762 filed on Aug. 26, 2008, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

The present invention relates to apparatus for garage doors.

BACKGROUND

Some prior art garage doors for homes and other buildings include door panels that are hinged together and which are configured to move between a closed position, wherein the door panels obstruct an opening in the building, and a raised position wherein the door panels are stored above the door opening so that the opening is unobstructed. In many garage doors, when in the raised position the door panels are positioned near the ceiling, with each door panel generally lying in the same horizontal plane. This configuration tends to obstruct a large area of the ceiling and requires a large framework of tracks and straps. This is undesirable as it makes the ceiling space unusable for storage or other uses.

Attempts have been made to overcome this problem. For example, U.S. Pat. No. 7,089,989 (Pfender) discloses a door with panels that fold together in an accordion-type configuration, wherein the panels stack together when the door is in the raised position. However, this arrangement tends to be complicated, expensive to manufacture, and often requires special hinging arrangements to withstand the forces associated with panel movement between the closed position and the open position.

Accordingly, there is a need for an improved garage door apparatus that overcomes at least some of the above noted disadvantages.

SUMMARY

According to one aspect of the invention, there is provided a garage door apparatus comprising a frame for mounting above an opening, the frame including a pair of spaced transverse frame members, a shaft rotatably coupled to the transverse frame members and extending along a longitudinal axis of rotation between the transverse frame members, a pair of spaced winding frames rigidly coupled to the shaft between the spaced transverse frame members, each of the winding frames having a plurality of side edges, a driver couplable to the shaft for rotating the shaft with respect to the transverse frame members, and at least five door panels hingedly coupled together and linked to the winding frames, each of the door panels being of equal width and having a longitudinal panel length, the plurality of door panels including at least one inner door panel and at least one outer door panel, wherein the winding frames are spaced apart a predetermined distance that is less than the longitudinal panel length of the plurality of door panels, such that when the winding frames are rotated by the driver about the axis of rotation, the side edges of the winding frames progressively engage each of the door panels, thereby moving the door panels between an extended position wherein the door panels obstruct the opening, and a retracted position wherein each door panel is wound onto one of the side edges of the winding frames, the opening is at least partially unobstructed, and the at least one outer door panel overlaps with the at least one inner door panel.

The inner door panels may be hingedly coupled together by inner hinges, and the outer door panels may be hingedly coupled together by outer hinges, with at least one of the inner hinges of the inner door panels having a common pivot axis with one of the outer hinges of the corresponding overlapping outer door panel when the door panels are in the retracted position.

The door panels may each have opposing panel side edges, and the inner hinges may be provided on the panel side edges of the inner door panels, and the outer hinges may be provided on the panel side edges of the outer door panels.

The outer hinges may be longitudinally spaced from the inner hinges to inhibit interference between the inner hinges and the outer hinges when the door panels move between the extended position and the retracted position.

The apparatus may further comprise a pair of guide channels configured to be mounted adjacent vertical sides of the opening for guiding the door panels as they move between the extended position and the retracted position.

The apparatus may further comprise rollers mounted within the channel guides, the roller sized and shaped for engaging with panel side edges as the door panels move between the extended position and the retracted position.

The door panels may be hingedly coupled together by hinges provided on the panel side edges, the hinges and panel side edges having grooves therein, and the rollers may be transversely mounted within the channel guides and configured to engage with the grooves as the door panels move between the extended position and the retracted position.

According to another embodiment of the invention, there is provided a garage door apparatus comprising a frame for mounting above an opening, the frame comprising a pair of spaced transverse frame members, a shaft rotatably coupled to the transverse frame members and extending along a longitudinal axis of rotation between the transverse frame members, a pair of spaced winding frames rigidly coupled to the shaft between the spaced transverse frame members, each of the winding frames having a plurality of side edges, a driver couplable to the shaft for rotating the shaft with respect to the transverse frame members, a plurality of elongate door panels hingedly coupled together and linked to the winding frames, each of the door panels being of equal width and having a longitudinal panel length, and each of the door panels having opposing panel side edges and hinges provided on the panel side edges for coupling with hinges on an adjacent door panel, each of the hinges and panel side edges having a groove therein, and a pair of guide channel assemblies for mounting adjacent opposite vertical sides of the opening, each guide channel assembly including rollers transversely mounted therein, the rollers sized and shaped for engaging with the grooves in the hinges and side edges as the door panels move between an extended position and a retracted position, and wherein the winding frames are spaced apart a predetermined distance that is less than the panel length of the plurality of door panels, such that when the winding frames are rotated by the driver about the axis of rotation, the side edges of the winding frames progressively engage each of the door panels thereby moving the door panels between the extended position wherein the door panels obstruct the opening, and the retracted position wherein each door panel is wound onto one of the side edges of the winding frames and the opening is at least partially unobstructed.

The door panels may further comprise a plurality of inner door panels and at least one outer door panel, the hinges may

further comprise inner hinges on the inner door panels and outer hinges on the outer door panels, and when the door panels are in the retracted position, each outer door panel may overlap with one inner door panel, and at least one of the inner hinges of the inner door panels have a common pivot axis with one of the outer hinges of the corresponding overlapping outer door panel when the door panels are in the retracted position.

The outer hinges may be longitudinally spaced from the inner hinges to inhibit interference between the inner hinges and the outer hinges as the door panels move between the extended position and the retracted position.

According to yet another aspect of the invention, there is provided a garage door apparatus comprising a frame for mounting above an opening, the frame comprising a pair of spaced transverse frame members and at least one longitudinal cross member extending between the transverse frame members, a shaft rotatably coupled to the transverse frame members and extending along a longitudinal axis of rotation between the transverse frame members, a pair of spaced winding frames rigidly coupled to the shaft between the spaced transverse frame members, each of the winding frames having a plurality of side edges, a driver couplable to the shaft for rotating the shaft with respect to the transverse frame members, and a plurality of elongate door panels hingedly coupled together, each of the door panels having a longitudinal panel length, the plurality of door panels including a first door panel linked to the winding frames, wherein the winding frames are spaced apart a predetermined distance that is less than the panel length such that when the winding frames are rotated about the axis of rotation, the side edges of the winding frames progressively engage each of the door panels, thereby moving the door panels between an extended position wherein the door panels obstruct the opening, and a retracted position wherein each door panel is wound onto one of the side edges of the winding frames and the opening is at least partially unobstructed.

The plurality of door panels may include at least four door panels of equal width, and each of the winding frames may have a square shape with four side edges.

The apparatus may further comprise a pair of guide channels configured to be mounted along vertical sides adjacent the opening for guiding the door panels as they move between the extended position and the retracted position. Each door panel may further comprise opposing panel side edges, and rollers mounted within the channel guides, the rollers sized and shaped for engaging with the panel side edges as the door panels move between the extended position and the retracted position. The door panels may be hingedly coupled together by hinges provided on the panel side edges, the hinges and panel side edges having grooves therein, and the rollers may be transversely mounted within the channel guides and configured to engage with the grooves as the door panels move between the extended position and the retracted position.

The door panels and frame may be configured so that the door panels form the sides of a transportation container when the door panels are in the retracted state.

In some embodiments, the door panels may comprise a plurality of inner door panels and at least one outer door panel, each door panel having panel side edges, and the door panels may be hingedly coupled together by inner hinges provided on the panel side edges of the inner door panels, and outer hinges provided on the panel side edges of the outer door panels, wherein, when the door panels are in the fully retracted position, each outer door panel overlaps with one inner door panel, with at least one of the inner hinges of the inner door panels having a common pivot axis with an outer hinge of the corresponding overlapping outer door panel. The outer hinges may be longitudinally spaced from the inner hinges to inhibit interference between the inner hinges and the outer hinges when the door panels move between the extended position and the retracted position.

The at least one longitudinal cross members may include a front cross member and a rear cross member.

Each frame member may have a first bracket mounted thereto, each first bracket configured to be engaged with a corresponding second bracket secured to a mounting surface above the opening.

Other aspects and features of the present specification will become apparent to those ordinarily skilled in the art upon review of the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings included herewith are for illustrating various examples of articles, methods, and apparatuses of the present specification and are not intended to limit the scope of what is taught in any way. In the drawings:

FIG. **1** is a rear perspective view of a garage door apparatus according to one embodiment with the door panels partially retracted;

FIG. **2** is a side perspective view of the apparatus of FIG. **1** with the door panels fully retracted;

FIG. **3** is a partial cross-sectional plan view of the apparatus of FIG. **2** taken through line **3-3**

FIG. **4** is a schematic side view of the apparatus of FIG. **1** with the door panels fully extended;

FIG. **5** is schematic side view of the apparatus of FIG. **1** with the door panels retracted;

FIG. **6** is a close-up perspective view of a portion of the apparatus of FIG. **1** with the door panels fully extended;

FIG. **7** is a schematic view of the apparatus of FIG. **1** with the door panels fully extended;

FIG. **8** is a schematic view of the apparatus of FIG. **1** with the door panels wound one quarter turn onto winding frames;

FIG. **9** is a schematic view of the apparatus of FIG. **8** with the door panels wound one half turn onto the winding frames;

FIG. **10** is a schematic view of the apparatus of FIG. **8** with the door panels wound three quarter turns onto the winding frames;

FIG. **11** is a schematic view of the apparatus of FIG. **8** with the door panels wound a full turn onto the winding frames;

FIG. **12** is a schematic view of the apparatus of FIG. **8** with the door panels wound five quarter turns onto the winding frames;

FIG. **13** is a perspective view of the apparatus of FIG. **1** with the frame decoupled from the mounting surface;

FIG. **14** is a side view of the apparatus of FIG. **1** showing details of mounting the frame to the mounting surface;

FIG. **15** is a perspective view of a guide channel assembly for use with a garage door apparatus according to another embodiment;

FIG. **16** is a side view of the guide channel assembly of FIG. **15**;

FIG. **17** is a side view of a hinge for use with the garage door apparatus of FIG. **15**;

FIG. **18** is a top view of the hinge of FIG. **17** engaged with the guide channel assembly of FIG. **15**;

FIG. **19** is a schematic end view of a garage door apparatus with outer door panels overlapping inner door panels according to another embodiment;

FIG. **20** is an elevation view of an outer hinge for use with the apparatus of FIG. **19**;

FIG. **21** is a end view of an outer hinge overlapping an inner hinge for the apparatus of FIG. **19**;

FIG. **22** is a cross sectional view of the outer hinge and inner hinge of FIG. **21** taken along line **24-24**;

FIG. **23** is a schematic end view of a garage door apparatus according to another embodiment;

FIG. **24** is a perspective view of a garage door apparatus according to yet another embodiment; and

FIG. **25** is a rear perspective view of the garage door apparatus of FIG. **24**.

DETAILED DESCRIPTION

Referring now generally to FIGS. **1** to **3**, illustrated therein is a garage door apparatus **10** according to one embodiment of the invention. The apparatus **10** generally includes a frame **14** having a pair of spaced transverse frame members **50**. The apparatus **10** also includes a shaft **18** rotatably coupled to the transverse frame members **50**, a pair of spaced winding frames **20** rigidly coupled to the shaft **18** and positioned in between the spaced frame members **50**, a driver **23** coupled to the shaft **18** for rotating the shaft **18** and the winding frames **20**, and a plurality of elongate door panels **24** hinged together and linked to the spaced winding frames **20**.

The frame **14** is mountable above an opening **12** in a wall, such as on a mounting surface **16** above the opening **12** in a wall of a garage. As shown, the frame **14** has a box-like shape. This shape is convenient as it allows the garage door apparatus **10** to be easily transported and delivered to a worksite as a ready-to-install assembly, as will be described in further detail below.

The shaft **18** is rotatably coupled to the transverse frame members **50** such that the shaft **18** may be rotated with respect to the transverse frame members **50**, and generally defines a longitudinal axis of rotation A.

Rigidly coupled to the shaft **18**, the winding frames **20** are spaced apart a predetermined distance D (as shown in FIG. **3**). Each winding frame **20** includes a plurality of side edges **22** that are generally shaped to progressively engage with the door panels **24** as the shaft **18** is rotated, as will be described in further detail below.

In some embodiments, as shown in FIG. **6** for example, each winding frame **20** may have a rectangular or square shape with four side edges **22**. The side edges **22** may include a first side edge **22***a*, a second side edge **22***b*, a third side edge **22***c* and a fourth side edge **22***d*. In other embodiments, each winding frame **20** may have a shape corresponding to another polygon, for example a triangle, a pentagon or hexagon.

As discussed above, the garage door apparatus **10** also includes a driver **23** coupled to the shaft **18**. The driver **23** is configured to rotate the shaft **18**, which in turn causes the winding frames **20** to rotate about the longitudinal axis of rotation A. The driver **23** may be a motor, for example an electric AC or DC motor. Alternatively, the driver **23** may be a manual cranking apparatus for manually rotating the shaft **18**, for example, a hand crank. In other embodiments, the driver **23** may include both an electric motor and a manually operated cranking apparatus.

In some embodiments, the apparatus **10** may include one or more biasing members configured to assist the driver **23** in raising and lowering the door panels **24**. For example, as shown in FIG. **3**, a coiled spring **56** may be coupled to the shaft **18** and to one of the transverse frame members **50** to counteract the weight of the door panels **24** during rotation of the winding frames **20**. The spring **56** may be accessible by a removable spring plate **59** which may be useful to replacing or servicing the spring **56**.

The apparatus **10** also includes a plurality of elongate door panels **24** that are movable with respect to the opening **12** to selectively obstruct and unobstruct the opening **12**. Each of the door panels **24** has a longitudinal panel length L and a panel width W, as shown in FIG. **3**. The panel length L is generally greater than the distance D between the winding frames **20**, but less that the distance between the transverse frame members **50**. It is generally desirable that each door panel **24** have the same shape and dimensions to enhance the aesthetic appeal of the garage door apparatus **10** when the door panels **24** are in the fully extended position. Accordingly, in some embodiments the panel length L and panel width W are equal for each of the door panels **24**. Adjacent door panels **24** are hingedly coupled together via hinges, which may be conventional hinges **27** or other hinges, for example the hinges described in further detail below.

In some embodiments, the apparatus **10** may include four door panels **24**, with a first door panel **24***a* (or uppermost door panel), a second door panel **24***b*, a third door panel **24***c* and a fourth door panel **24***d*. For example, the apparatus **10** may include the door panels **24***a*, **24***b*, **24***c*, and **24***d*, shown in FIG. **4** fully unwound from the winding frames **20** (with the opening **12** obstructed), and shown in FIG. **5**, fully wound onto the winding frames **20** with the opening **12** unobstructed.

The door panels **24** are linked to the winding frame **20** so that they may be wound onto the winding frames **20**. For example, the first door panel **24***a* may be flexibly linked to the winding frames **20** by a link arm **20** or other connector, as shown for example in FIGS. **4** to **6**. The link arm **20** may be a rigid link member having a length generally equal to the panel width W and a link thickness Q. Alternatively, the link arm **20** may be a flexible chain or other non-rigid link member.

In some embodiments, each winding frame **20** may include a link arm flange **42** adjacent each link arm **40** (as shown in FIGS. **6** and **7**). Each link arm flange **42** extends generally inwardly from each winding frame **20** (towards the opposite winding frame **20**), and has an abutting surface **44** thereon generally facing the link arm **40**, the surface **44** being sized and shaped to receive the link arm **40**. The flange **42** is offset from one of the side edges **22** of the winding frames **20** (e.g. the second side edge **22***b*) by a distance P generally equal to the thickness Q of the link arms **40**. During rotation of the winding frames **20**, each link arm **40** may be received on the abutting surface **44** such that the link arm **40** is positioned below the second edge **22***b* and does not interfere with engagement between the door panels **24** and the side edges **22** of the winding frames **20** (e.g. between the fourth door panel **24***d* with the second edge **22***b*).

The garage door apparatus **10** may also include guide wheels **48** or other guide members. The guide wheels **48** or other guide members are configured to bias the link arms **40** and the door panels **24** generally away from the winding frames **20** during rotation of the winding frames **20** such that the door panels **24** and link arms **40** tend not to interfere with the rotation of the winding frames **20**. The guide wheels **48** also tend to facilitate proper alignment of the door panels **24** with respect to the opening **12**.

The apparatus **10** may also include one or more guide channels **34** configured to be mounted on opposite vertical sides adjacent the opening **12**. The guide channels **34** engage with the door panels **24** and tend to the ensure the that the door panels **24** are properly positioned with respect to the opening **12** as the door panels move between the extended (unwound) and retracted positions. In some embodiments, the guide channels **34** include a recessed portion **36**, which may be sized and shaped to receive the door panels **24** therein.

In some embodiments, the guide channels **34** may include wheels or rollers **38** mounted in the recessed portion **36** of the guide channels **34** for assisting in guiding the door panels **24**. In alternative embodiments, rollers may be provided on the door panels **24** for engaging with corresponding surfaces in the guide channels **34**.

During use of the apparatus **10**, the driver **23** may be activated causing the shaft **18** to rotate with respect to the transverse frame members **50**. The rotation of the shaft **18** in turn causes the winding frames **20** rotate about the longitudinal axis of rotation A. As this happens, the side edges **22** of the winding frames **20** each progressively engage one of the door panels **24**, thereby moving the door panels **24** between the extended position (as shown in FIG. **4**) and the retracted position (as shown in FIG. **5**). Each door panel **24** is thus wound onto one of the side edges **22** of the winding frames **20**.

For example, in FIGS. **4** and **7** the door panels **24** are shown in a fully extended position, and the opening **12** is obstructed. To retract the door panels **24** (i.e. to unobstruct the opening), the winding frames **20** are rotated by the driver **23** in a first direction (e.g. clockwise). As shown in FIG. **8**, the winding frames **20** may be rotated a ¼ turn clockwise from the fully extended position, with the door panels **24** retracted by a distance equal to the width W of one door panel **24**. In this position, the link arm **20** is engaged with the abutting surface **44** of the link arm flange **42**, with the outer edge of the link arm **20** generally below the second side edge **22***b*, and the first door panel **24***a* is engaged with the guide wheel **48** (as shown in FIG. **8**).

As the driver **23** continues to rotate the shaft **18** another ¼ turn clockwise, the winding frames **20** are rotated a ½ turn from the fully extended position, and the door panels **24** are retracted by a distance equal to the width of two door panels **24**. In this position, the uppermost or first panel **24***a* is wound onto the third side edge **22***c* of the winding frames, and the second door panel **24***b* is engaged with the guide wheel **48** (as shown in FIG. **9**).

As the driver **23** continues to rotate the shaft **18** another ¼ turn clockwise, the winding frames **20** are rotated ¾ turns from the fully extended position, and the door panels **24** are retracted by a distance equal to the width of three door panels **24**. In this position, the second door panel **24***b* is wound onto the fourth side edge **22***d*, and the third door panel **24***c* is engaged with the guide wheel **48** (as shown in FIG. **10**).

As the driver **23** continues to rotate the shaft **18** another ¼ turn clockwise, the winding frames **20** are rotated by a full turn from the fully extended position, and the door panels **24** are retracted by a distance equal to the width of four door panels **24**. In this position, the third door panel **24***c* is wound onto the first side edge **22***d*, and the fourth door panel **24***d* is engaged with the guide wheel **48** (as shown in FIGS. **5** and **11**). In this position, the opening **12** is generally fully open, and thus objects may be moved through the opening **12**. For example, the opening **12** may be used to receive a vehicle in the garage.

To lower the door panels **24** (e.g. to move the door panels **24** from the retracted position to the extended position in order to close the garage door), the driver **13** may be rotated in a second direction opposite the first direction (e.g. counter-clockwise in the example shown).

In some embodiments, the driver **23** may rotate the winding frames **20** beyond a full turn to completely disengage the door panels **24** from the guide wheels **48**. For example, as shown in FIG. **12**, the winding frames **20** may be rotated clockwise by 5/4 turns from the fully extended position, fully retracting the door panels **24** onto the winding frames **20**. In this position, the fourth door panel **24***d* is wound onto the second side edge **22***b*, and the door panels **24** have been disengaged from the guide wheel **48**. This fully-retracted configuration may be useful for removing or installing the frame **14** above the opening **12**. For example, as shown in FIG. **13**, the garage door apparatus **10** may be delivered to a worksite with the door panels **24** provided in a fully retracted state, allowing for easy delivery and mounting of the apparatus **10** to the mounting surface **16**.

In some embodiments, the frame **14** may be mounted to the mounting surface **16** using brackets or other suitable mounting apparatus. For example, as shown in FIGS. **13** and **14**, bracket portions **60** may be secured to the mounting surface **16** above the opening **12**. Once the portions **60** are secured, the garage door apparatus **10** may be lifted in place above the opening **12** and secured above the opening by engaging locking tabs **62** that extend outwardly from the bracket portions **60** with corresponding slots **64** in the frame members **50**.

With the door panels **24** provided in the fully-retracted position, the door panels **24** will tend not to interfere with the engagement between the tabs **62** and the slots **64**. Once the garage door apparatus **10** is mounted above the opening **12**, the door panels **24** can be lowered into place and engaged with the guide wheels **48**.

In some embodiments, with the door panels **24** in the fully-retracted position, the door panels **24** may be coupled to the frame **14** such that the door panels **24** are secured in place and will not unwind from the winding frames **20**, forming a secure rectangular "box". This shape tends to be convenient for shipping of the garage door apparatus **10**, and may provide a useful transportation container usable to transport other components therein. For example, the transportation container formed by the door panels **24** and the frame **14** may be used to store the driver **23** and the guide channels **34** therein.

In some embodiments, pins or other fastening devices may be used to secure the frame members **50** to the winding frames **20** to inhibit relative rotation thereof during movement and/or transportation of the frame **14**.

In some embodiments, one or more of the transverse frame members **50**, winding frames **20** and door panels **24** may include one or more openings or removable portions **58** for allowing access to the interior of the apparatus **10** when the door panels **24** are formed into a transportation container, allowing access to components inside the transportation container.

As shown in FIG. **4**, the frame **14** is generally mounted to the wall **16** with the winding frames **20** offset from the wall or mounting surface **16** by an offset distance S. The offset distance S is selected such that the door panels **24** will tend not interfere with the wall **16** during rotation of the winding frames **20**.

Due to the offset distance S, each the door panels **24** is generally disposed at an acute angle **46** as it engages with and is wound onto the winding frames **20**. The offset distance S may be selected to be as small as possible so that the acute angle **46** is minimized.

Turning now to FIGS. **15** to **18**, according to some embodiments of the invention, each door panel **24** may be hingedly connected to each other by hinges **28** mounted to side panel edges **26**, instead of conventional hinges **27** mounted to interior surfaces of the door panels **24**. For example, as shown in FIG. **15**, the adjacent third door panel **24***c* and fourth door panel **24***d* may be hingedly coupled together via hinge **28** having a first hinge portion **28***a* and a second hinge portion **28***b*, jointed at a common pivot axis **30** using a hinge pin **31**. The hinges **28** allow the door panels **24** to flexibly move with respect to one another and to be wound onto the winding

frames **20** as the door panels **24** are moved between the extended position and the retracted position.

As shown in FIG. **17**, the ends of the hinges **28** and/or the panels **24** may have corresponding irregular profiles **29**. The shape of the profiles **29** may tend to inhibit water from flowing between adjacent panels **24**.

In some embodiments, each hinge member **28** and panel side edge **26** may have a concave groove **32** defined therein that generally runs along the length of the hinge **28** and the panel side edge **26** (as shown in FIGS. **17** and **18**). The wheels or rollers **38** may be transversely mounted within the guide channels **34** such that a portion **39** of the each roller **38** protrudes beyond a leading edge **41** of the guide channels **34** (as shown in FIGS. **16** and **18**). In this manner, the protruding portion **39** of each roller tends to engage with the grooves **32** in the hinges **28** and panel side edges **26** as the door panels **24** move between the extended position and the retracted position, and keep the door panels **24** properly aligned with respect to the guide channels **34** (as shown in FIG. **18**).

In some embodiments, the rollers **38** may be configured to apply a biasing force against the grooves **32**. For example, the rollers **38** may be mounted on pins **66** that are movably received within slots **68** in the guide channels **34**, and the pins **66** may be spring-loaded, for example via a spring **70**.

Turning now to FIGS. **19** to **22**, in some embodiments, a garage door apparatus **80** may include at least at least five door panels, with a number of inner door panels **82** and at least one outer door panel **84** configured to overlap at least one of the inner door panels **82**. For example, the garage door apparatus **80** as shown has eight door panels, including four inner door panels **82***a*, **82***b*, **82***c*, and **82***d* (generally similar to door panels **24***a*, **24***b*, **24***c*, and **24***d* as described above), and four outer door panels **84***a*, **84***b*, **84***c* and **84***d*. The inner door panels **82** are hingedly coupled together, with the first inner door panel **82***a* connected to the second inner door panel **82***b*, the second panel connected to the third panel **82***c*, and so on. Similarly, the outer door panels **84** are hingedly coupled together, with the first outer door panel **84***a* connected to the second outer door panel **84***b*, and so on. To couple the inner door panels **82** to the outer door panels **84**, the fourth inner door panel **82***d* is hingedly coupled to the first outer door panel **84***a*.

When the garage door apparatus **80** is in the retracted position, the inner door panels **82** generally engage the first four edges **22** of the winding frames **20**, similar to as generally described above, and each of the outer door panels **84** overlaps with one of the inner door panels **82**. For example, as shown in FIG. **19**, the first outer door panel **84***a* overlaps with the first inner door panel **82***a*, the second outer door panel **84***b* overlaps with the second inner door panel **82***b*, the third outer door panel **82***c* overlaps with the third inner door panel **82***c* and the fourth outer door panel **84***d* overlaps with the fourth inner door panel **82***d*.

It is generally desirable in some embodiments that the inner door panels **82** and outer door panels **84** have substantially the same dimensions, particularly the door widths W. This may be desirable to provide for an improved aesthetic appearance when the inner door panels **82** and outer door panels **84** are in the fully extended position, and furthermore may simplify the manufacturing of the inner door panels **82** and outer door panels **84**. To accommodate this, the inner door panels **82** and outer door panels **84** may be configured to accommodate this overlap. For example, the inner door panels **82** may be hingedly coupled together using inner hinges **86**, while the outer door panels **84** may be hingedly coupled together using outer hinges **88**.

The inner hinges **86** are generally similar to the hinges **28** described above. The outer hinges **88**, however, are configured to generally extend and overlap with the inner hinges **86** when the outer door panels **88** are in an overlapping position with the inner door panels **82**, such that each outer hinge **88** shares a common pivot axis **89** with one of the inner hinges **86**.

For example, as shown in FIGS. **19**, **21** and **22**, the third inner door panel **82***c* has a first inner hinge portion **86***a* mounted thereto, the first inner hinge portion **86***a* being coupled to a second inner hinge portion **86***b* mounted to the fourth inner door panel **82***d*. The first inner hinge portion **86***a* and second inner hinge portion **86***b* are coupled together via a first hinge pin **81**, and are pivotable with respect to each other about a first pivot axis **89***a*.

Similarly, the third outer door panel **84***c* has mounted thereto a first outer hinge portion **88***a*, which is in turn coupled to a second outer hinge portion **88***b* mounted to the fourth outer door panel **84***d*. The first and second outer hinge portions **88***a*, **88***b* are pivotably coupled by an outer hinge pin **83** and pivot about the same pivot axis **89***a* as the inner hinge members **86***a*, **86***b*.

As shown in FIG. **22**, the first and second outer hinge portions **88***a*, **88***b* may be longitudinally offset from the inner hinge portions **86***a*, **86***b* such that the inner hinges **86** and outer hinges **88** do not interfere with each other as the inner door panels **82** and outer door panels **84** are moved between the extended position and the retracted position.

Turning now to FIG. **23**, a garage door apparatus **90** according to yet another alternative embodiment of the invention is shown. The garage door apparatus **90** includes a first door panel **92***a* and second door panel **92***b*, coupled to third, fourth, fifth and sixth door panels **92***c*, **92***d*, **92***e*, **92***f*. The apparatus **90** also includes spaced winding frames **96** coupled to a shaft **95** similar to the winding frames **20** and shaft **18** described above. The winding frames **96** have side edges **97***a*, **97***b*, **97***c*, and **97***d*, and also include first and second angled flanges **98**, **99** mounted thereto.

The first door panel **92***a* and second door panel **92***b* which have a short panel length L**2** that is less than the distance D between the spaced winding frames **96**, while the other door panels **92***c*, **92***d*, **92***e*, **92***f* have a panel length L that is greater that the distance D between the spaced winding frames **96**. Similar to as above, as the winding frames **96** are rotated by the shaft **95**, the side edges **97** of the winding frames **96** progressively engage each of the door panels **92**, thereby moving the door panels **92** between an extended position wherein the door panels obstruct the opening, and a retracted position wherein the opening is at least partially unobstructed.

As this happens, however, the short panel length L**2** of the first door panel **92***a* and second door panel **92***b* being less that the distance D between the winding frames **96**, the first door panel **92***a* and second door panel **92***b* will not engage the winding frames **96**, but rather will come to rest against the first angled flange **98** and the second angled flange **99**, respectively. The third through sixth panels **92***c*, **92***d*, **92***e*, and **92***f*, will then be wound onto the edges **97***a*, **97***b*, **97***c*, and **97***d* of the winding frame **96** similar to as generally described above, encapsulating the first and second panels **92***a*, **92***b* therein.

Referring now to FIGS. **24** and **25**, illustrated therein is a garage door apparatus **110** according to yet another embodiment of the invention. The apparatus **110** generally includes a frame **114** having a pair of spaced transverse frame members **150** and longitudinal cross members **152**, **154** that extend between the frame members **150**. The apparatus **110** also includes a shaft **118** rotatably coupled to the transverse frame

members **150**, a pair of spaced winding frames **120** rigidly coupled to the shaft **118** and positioned in between the spaced frame members **150**, a driver **123** coupled to the shaft **118** for rotating the shaft **118** and the winding frames **120**, and a plurality of elongate door panels **124** hinged together and linked to the spaced winding frames **120**.

As shown, the front cross member **152** and rear cross member **154** join the two spaced transverse frame members **150** together, giving the frame **114** a box-like shape. The cross members **152**, **154** of the frame **114** are positioned on the frame members **150** with respect to the winding frames **120** so as not to interfere with the movement of the door panels **124** as the winding frames **120** are rotated. The frame **114** may be mounted above an opening using brackets **160**.

While the above description provides examples of one or more articles, methods, and apparatuses, it will be appreciated that other articles, methods, and apparatuses may be within the scope of the present description as interpreted by one of skill in the art.

The invention claimed is:

1. A garage door apparatus, comprising:

a) a frame for mounting above an opening, the frame comprising a pair of spaced transverse frame members;

b) a shaft rotatably coupled to the transverse frame members and extending along a longitudinal axis of rotation between the transverse frame members;

c) a pair of spaced winding frames rigidly coupled to the shaft between the spaced transverse frame members, each of the winding frames having a plurality of side edges;

d) a driver couplable to the shaft for rotating the shaft with respect to the transverse frame members;

e) a plurality of elongate door panels hingedly coupled together and linked to the winding frames, each of the door panels being of equal width and having a longitudinal panel length, and each of the door panels having opposing panel side edges and hinges provided on the panel side edges for coupling with hinges on an adjacent door panel, each of the hinges and panel side edges having a groove therein; and

f) a pair of guide channel assemblies for mounting adjacent opposite vertical sides of the opening, each guide channel assembly including rollers transversely mounted therein, the rollers sized and shaped for engaging with the grooves in the hinges and side edges as the door panels move between an extended position and a retracted position; and

g) wherein the winding frames are spaced apart a predetermined distance that is less than the panel length of the plurality of door panels, such that when the winding frames are rotated by the driver about the axis of rotation, the side edges of the winding frames progressively engage each of the door panels thereby moving the door panels between the extended position wherein the door panels obstruct the opening, and the retracted position wherein each door panel is wound onto one of the side edges of the winding frames and the opening is at least partially unobstructed.

2. The apparatus of claim **1**, wherein the plurality of door panels includes at least four door panels of equal width, and each of the winding frames has a square shape having four side edges.

3. The apparatus of claim **1**, wherein the door panels and frame are configured so that the door panels form the sides of a transportation container when the door panels are in the retracted state.

4. The apparatus of claim **1** wherein each frame member has a bracket for mounting to a mounting surface above the opening.

5. The apparatus of claim **1** wherein:

a) the door panels comprise a plurality of inner door panels and at least one outer door panel;

b) the hinges comprise inner hinges on the inner door panels and outer hinges on the outer door panels; and

c) when the door panels are in the retracted position, each outer door panel overlaps with one inner door panel, and at least one of the inner hinges of the inner door panels have a common pivot axis with the outer hinges of the corresponding overlapping outer door panel when the door panels are in the retracted position.

6. The apparatus of claim **5**, wherein the outer hinges are longitudinally spaced from the inner hinges to inhibit interference between the inner hinges and the outer hinges as the door panels move between the extended position and the retracted position.

7. The apparatus of claim **1**, further comprising at least one longitudinal cross member extending between the transverse frame members.

8. The apparatus of claim **7**, wherein the at least one longitudinal cross member includes a front cross member and a rear cross member.

9. A garage door apparatus, comprising:

a) a frame for mounting above an opening, the frame comprising a pair of spaced transverse frame members and at least one longitudinal cross member extending between the transverse frame members;

b a shaft rotatably coupled to the transverse frame members and extending along a longitudinal axis of rotation between the transverse frame members;

c) a pair of spaced winding frames rigidly coupled to the shaft between the spaced transverse frame members, each of the winding frames having a plurality of side edges;

d) a driver couplable to the shaft for rotating the shaft with respect to the transverse frame members; and

e) a plurality of elongate door panels hingedly coupled together, each of the door panels having a longitudinal panel length, the plurality of door panels including a first door panel linked to the winding frames;

f) wherein the winding frames are spaced apart a predetermined distance that is less than the panel length such that when the winding frames are rotated about the axis of rotation, the side edges of the winding frames progressively engage each of the door panels thereby moving the door panels between an extended position wherein the door panels obstruct the opening, and a retracted position wherein each door panel is wound onto one of the side edges of the winding frames and the opening is at least partially unobstructed;

g) further comprising a pair of guide channels configured to be mounted along vertical sides adjacent the opening for guiding the door panels as they move between the extended position and the retracted position;

h) wherein each door panel comprises opposing panel side edges, and further comprising rollers mounted within the channel guides the rollers sized and shared for e a in with the panel side edges as the door panels move between the extended position and the retracted position; and

i) wherein the door panels are hingedly coupled together by hinges provided on the panel side edges, the hinges and panel side edges having grooves therein, and the rollers are transversely mounted within the channel guides and configured to engage with the grooves as the door panels move between the extended position and the retracted position.

10. The apparatus of claim **9**, wherein the plurality of door panels includes at least four door panels of equal width, and each of the winding frames has a square shape having four side edges.

11. The apparatus of claim **9**, wherein, the door panels and frame are configured so that the door panels form the sides of a transportation container when the door panels are in the retracted state.

12. The apparatus of claim **9**, wherein the at least one longitudinal cross member includes a front cross member and a rear cross member.

13. The apparatus of claim **9** wherein each frame member has a bracket for mounting to a mounting surface above the opening.

14. The apparatus of claim **9**, wherein:

a) the door panels comprise a plurality of inner door panels and at least one outer door panel, each door panel having panel side edges; and

b) the door panels are hingedly coupled together by inner hinges provided on the panel side edges of the inner door panels, and outer hinges provided on the panel side edges of the outer door panels;

c) wherein, when the door panels are in the fully retracted position, each outer door panel overlaps with one inner door panel, with at least one of the inner hinges of the inner door panels having a common pivot axis with one of the outer hinges of the corresponding overlapping outer door panel.

15. The apparatus of claim **14**, wherein the outer hinges are longitudinally spaced from the inner hinges to inhibit interference between the inner hinges and the outer hinges when the door panels move between the extended position and the retracted position.

* * * * *